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Monthly Bulletin of the International Railway Congress Association

(English Edition)

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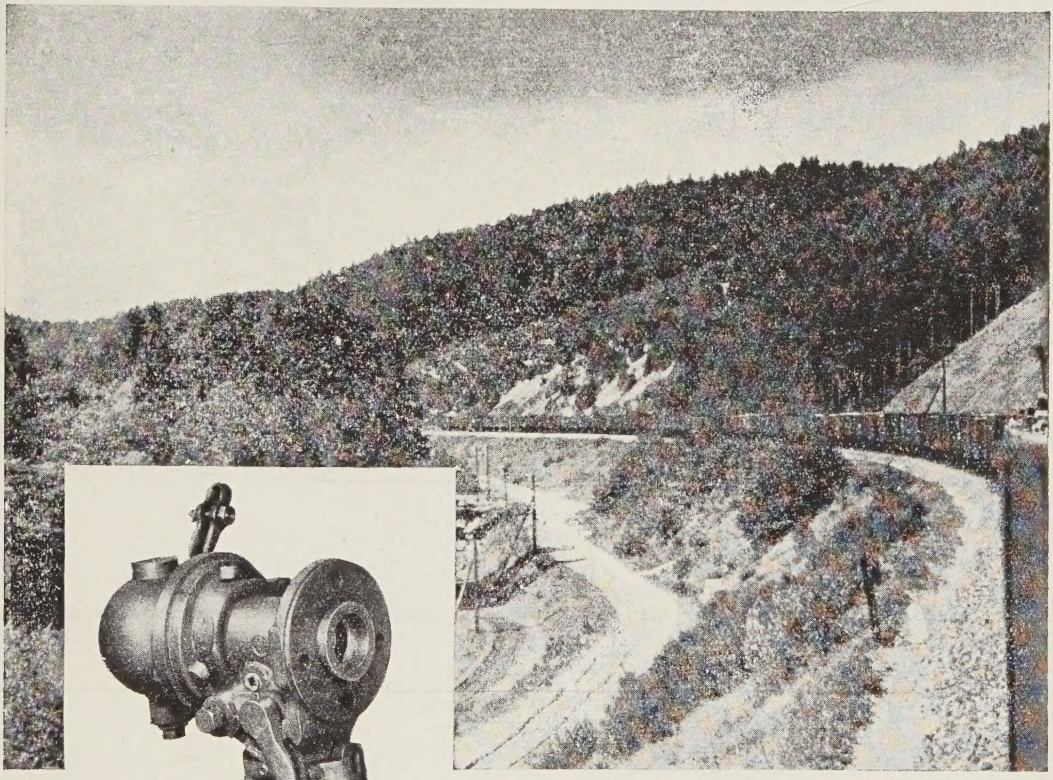

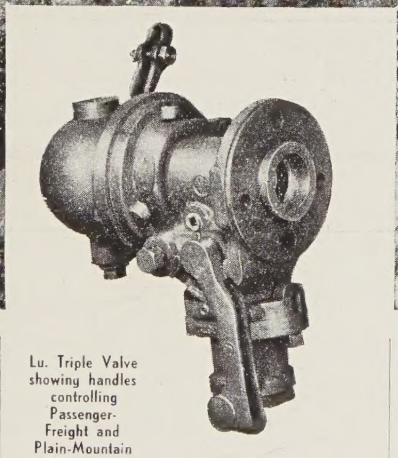

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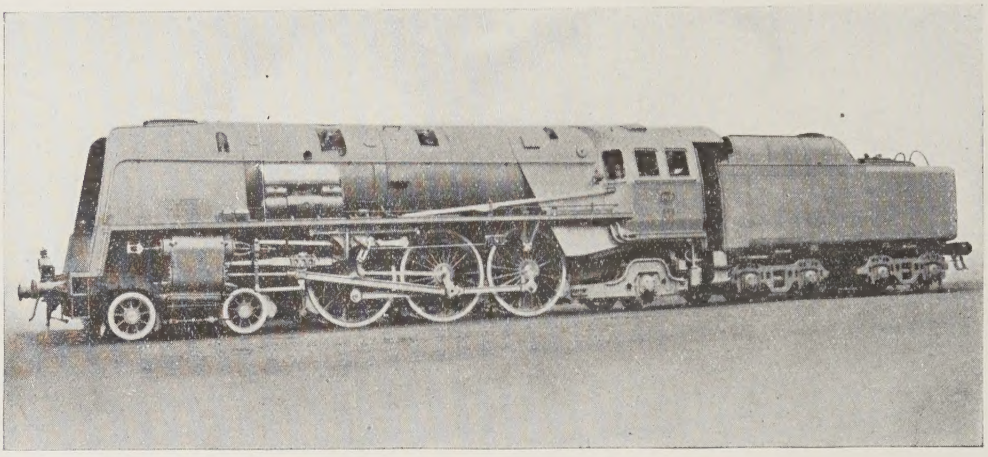

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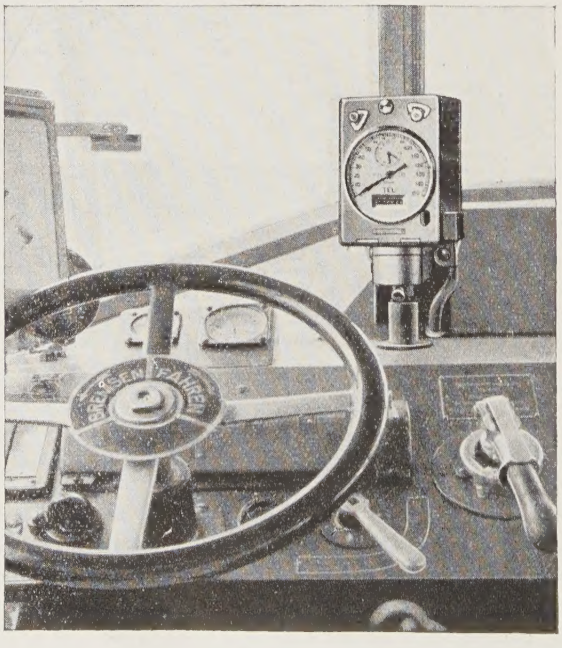

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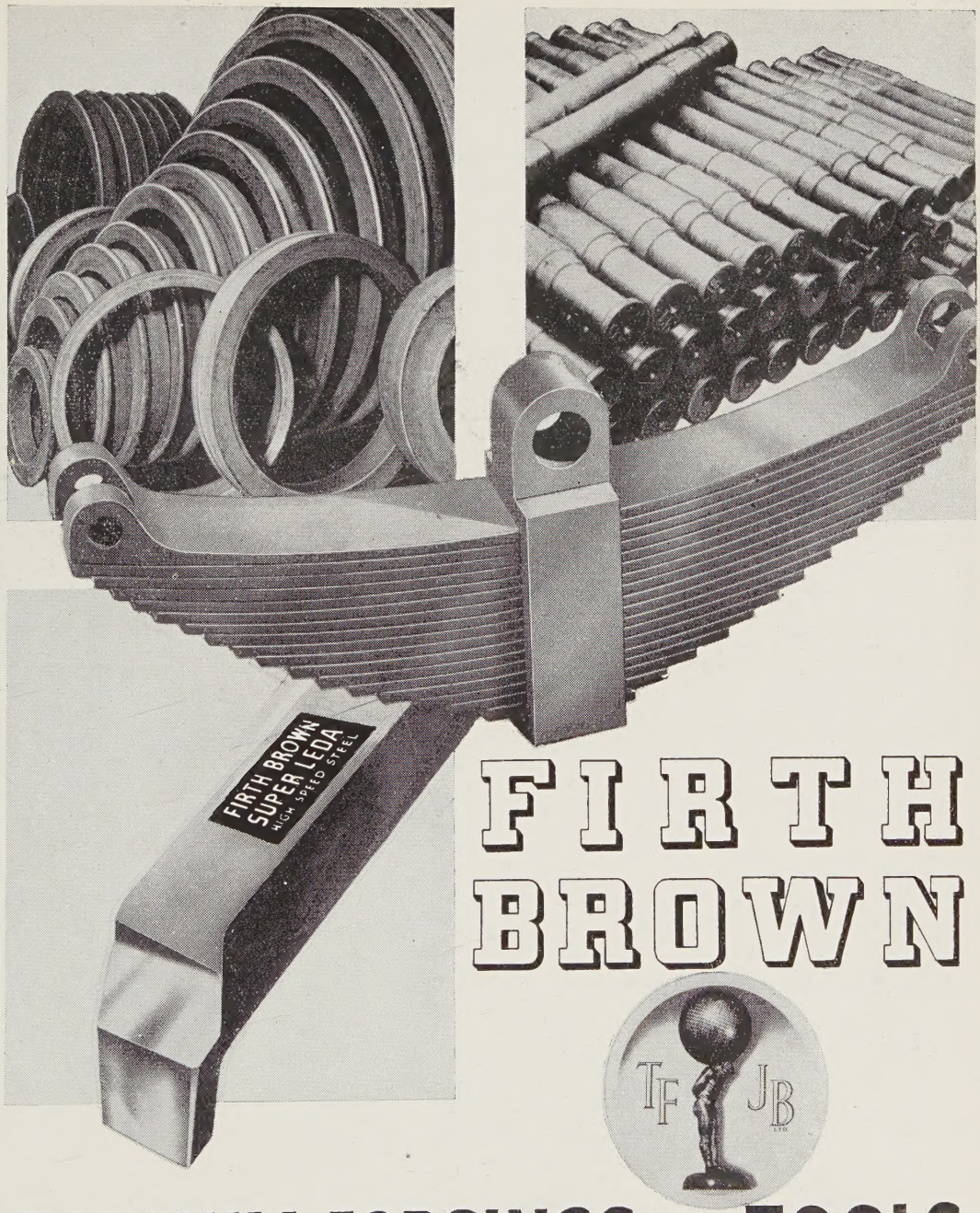

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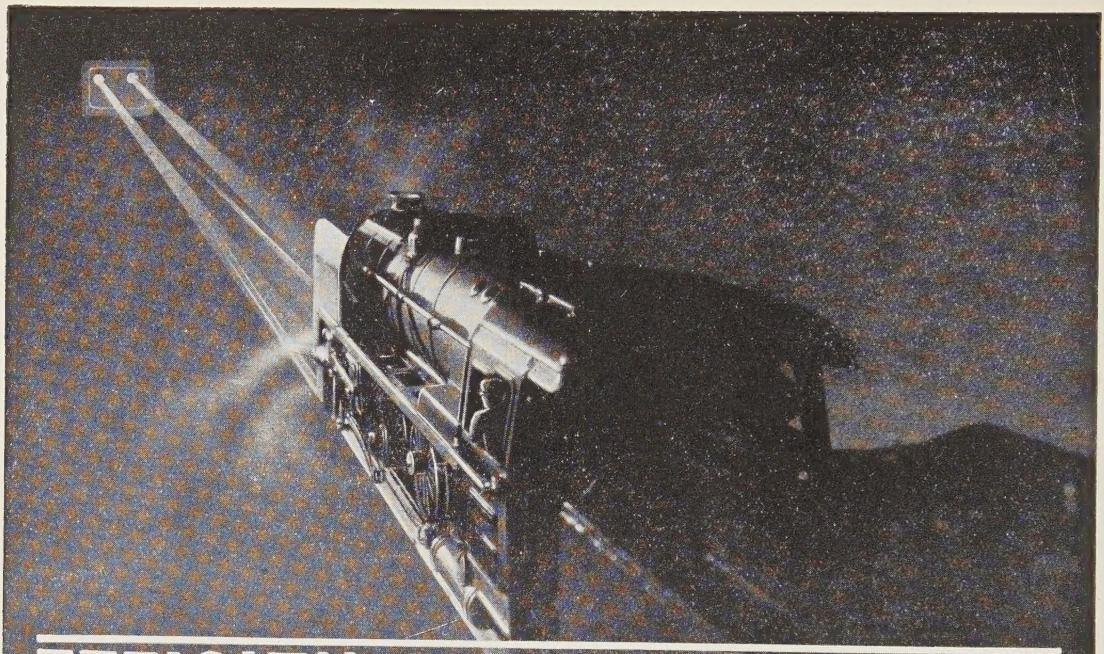

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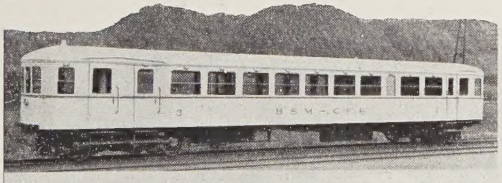

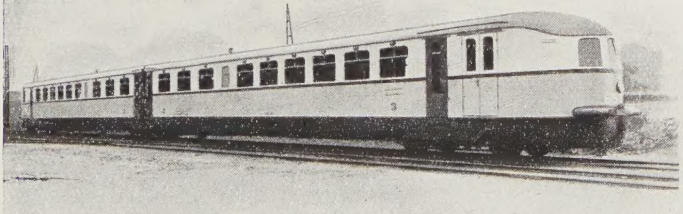

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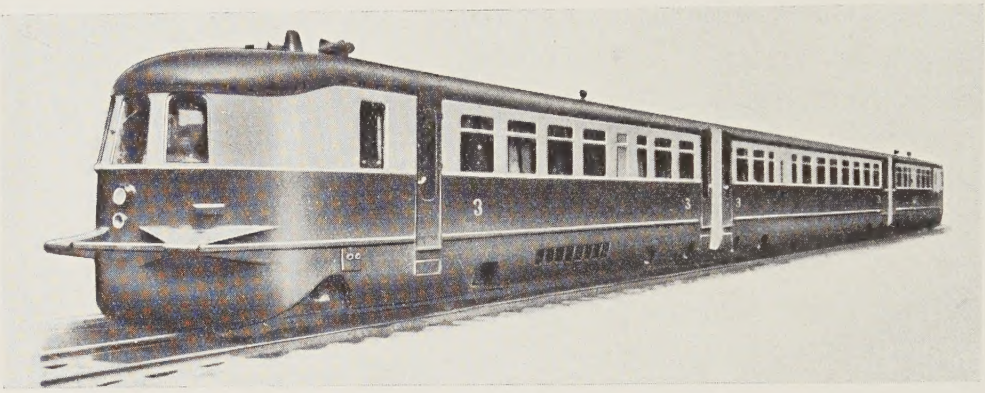

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MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

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Advertisements : All communications should be addressed to the Association, **19, rue du Beau Site, Brussels.**

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An edition in French is also published.

VOL. XXIV. — No. 5. May 1947.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[385 .517 .7]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

14th. SESSION (LUCERNE, 1947).

QUESTION IV.

The interest the Railway Companies would have in building houses for their staff of all ranks, or in assisting the building of such houses.

SUPPLEMENT TO REPORT (*)

by E. L. ANTONUCCI,

Ingénieur, Inspecteur en Chef des Chemins de fer de l'État Italien.

After the compilation of the report on the above question, published in the *Bulletin* of March 1947, the following Administrations replied to the questionnaire :

1. BELGIUM : Lower Congo-Katanga Railway Company.
2. SPAIN : Spanish National Railways.
3. FRANCE : French National Railways.
4. FRANCE : Madagascar Railways.
5. GREECE : State Railways.
6. LUXEMBURG : Luxemburg Railways.
7. PORTUGAL: Mozambique Harbour and Railway Company.

Consequently the information given at the beginning of the chapter « General Remarks » must be modified as follows :

— Administrations who replied : 41, 8 of which are of great importance from the point of view of the extent of their system, followed by 20 Administrations operating a minimum of some 1 000 km. (621 miles) to a maximum of 5 000 km. (3 106 miles) ;

— Administrations who did not reply : 56, 10 of which operate more than 1 000 km. up to a maximum of some 10 000 km. (6 213 miles), and 46 operating less than 1 000 km.

The Lower-Congo Katanga Railway (Belgium) with 2 506 km. (1 557 miles) of line stated that the ques-

(*) See *Bulletin of the International Railway Congress Association*, March 1947, p. 277/21.

tionnaire did not apply to them, seeing that all the staff on this colonial railway are housed while in Africa by the Company according to the terms of their engagement.

The other Administrations supplied the following information concerning the 14 questions of which the questionnaire was composed :

QUESTION 1.

Please give the reasons (technical and economic) which led your Administration to build houses for its employees or assist in the construction of such houses.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Subaltern grades of staff actively employed on the railway : clerks, employees of the Permanent Way & Works, Traction, Operating, Electrification Departments, etc., are accommodated by the Spanish National Railways (or enabled to profit by that known as « dwellings protected by the Spanish State »), owing on the one hand to the shortage of accommodation in nearly all the Spanish towns, and on the other to the necessity for employees being available at all times at their place of work, and also to facilitate the transfer of staff whenever this is necessary for service reasons.

2. FRANCE : a) *French National Railways.*

The object of the French National Railways in building homes for their staff is both professional and social.

The French National Railways by providing accommodation for those employees who must live near their place of work, are only meeting the requirements of the service, which are constantly increasing in order to keep pace with modern progress. The intensity of the traffic, the complexity of modern equipment, and the increasingly thorough technical organisation of a railway all mean that more and more employees must be housed near their place of work. Their work as well as their home life must necessarily benefit if they are comfortably housed.

In addition to the necessity for building homes for service reasons, the French National Railways are naturally concerned with improving the living conditions of their staff by supplementing any shortage of accommodation to be let in railway centres.

b) *Madagascar Railways.*

Mountain railways, which are generally single track lines in the Colonies, are very vulnerable during the winter, and the only way te prevent accidents and restore the lines to traffic as quickly as possible is to have gangs available both day and night living alongside the permanent way.

3. GREECE : *State Railways.*

The reasons which led this Administration to build accommodation for certain categories of staff at the place where they work are based on social considerations as well as the need for making it possible for employees whose duties make it imperative for them to be available at all hours to live where service requirements indicate.

4. LUXEMBURG : *Luxemburg Railways.*

The reasons which led the Administration to build accommodation for their staff are :

— Shortage of private accommodation in the large towns;

— Possibility of transferring staff whenever service requirements make it necessary;

— The advantages obtained by the

Administration in housing staff near their place of work.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

The reasons which led the Administration to build homes for their staff are the following :

— Necessity for housing staff near their place of work;

— The fact that it is hard to find suitable accommodation for Europeans in the Colony, which staff can rent;

— Necessity for improving living conditions for staff by housing them rent free, or at low rents.

QUESTION 2.

What is the policy of your Railway regarding the situation, purpose and allocation of houses for employees?

Do you provide houses for all grades of employees or only for certain grades? Please give details, also describing the different categories of houses available for the above mentioned cases.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Accommodation is provided alongside the permanent way for members of permanent way gangs and for crossing keepers at level crossings. Foremen gangers generally are housed in or near the station belonging to their section of line.

Certain superintendents and assistant superintendents of the Way & Works Department are housed in the station buildings, or in detached buildings, which also contain the offices for the section. All inspectors are housed in the district under their charge.

In the case of the Operating Department, all the chief inspectors, certain assistant inspectors, and stationmasters (in the case of important stations) are housed by the National Railways, either in the railway buildings or in separate houses.

The stationmaster, signalman, and one or two pointsmen live in the smaller stations.

At certain stations at a distance from urban centres, there are groups of houses for Operating Department staff.

In the case of the Traction Department, only the superintendents and assistant superintendents of sheds and electric depots are housed by the National Railways near the sheds and depots.

Staff attached to other Departments, which may be termed « passive », are not housed by the National Railways unless this is specially authorised.

In several stations which are a long way away from any centres, there are rooms or dormitories for employees who have to carry out any lengthy jobs in the locality.

When accommodation becomes vacant or new buildings are available, in allocating it absolute preference is given to employees with a recognised right *to be housed rent free,* such as those who must be available to repair interrupted communications, stationmasters, traffic controllers, shed superintendents, etc.

Any remaining accommodation is rented to employees whose duties are bound up with the active running of the railway and the train services, i.e. from Way & Works Department Superintendents, Operating Department inspectors, foremen in charge of mobile equipment, chief inspectors, etc., down to gangers and pointsmen.

Any accommodation that remains is allocated to those who want it for a small rent, whenever this fits in with service requirements, and there are no employees with a prior right to such accommodation.

2. FRANCE : a) *French National Railways.*

The accommodation provided for all grades of staff can be divided into two classes :

a) that which goes with certain jobs;

b) that which employees are allowed to rent.

A) *Accommodation which goes with the job.*

Certain employees are housed rent free; others must live in the accommodation provided for which they pay a small rent.

The former are employees who must live in a service house attached to their job, for example :

— stationmasters, and assistants stationmasters, stationmasters in charge of small stations and halts; those in charge of the railway cartage services, those in charge of sheds, assistant superintendents, permanent way inspectors, crossing keepers and watchmen.

The latter employees are simply enabled to live near their place of work where accommodation is reserved for them, for example those responsible for districts or important shops, divisional inspectors, inspectors, assistant inspectors, those responsible for working the traffic and for upkeep and maintenance.

B) *Accommodation rented to employees.*

The French National Railways have a certain amount of accommodation built for the purpose which they can rent to employees. The object of this is to improve their living conditions and facilitate their work. Such accommodation is let to employees at rents so determined as to be comparable with the current rents for privately owned accommodation.

Such accommodation is allocated at the request of the staff according to a waiting list, taking into account the employee's job, the distance he lives from work, his family position, etc.

Housing commissions or local committees on which the staff is represented allocate the available accommodation.

b) *Madagascar Railways.*

This Administration considers that it is very important for the good running of a colonial railway to have certain categories of employees housed by the Administration close to railway centres. Though this principle need not be strictly adhered to in the large centres, it should always be respected in small places.

In the case of gangers, it is essential that these should be housed in the immediate vicinity of the permanent way so that they can be called upon by day or night as required.

The policy of this Administration is to build homes for all its staff in every place, but they have always been prevented from doing so fully either on account of financial crises or because of critical shortages of labour and materials.

3. GREECE : *State Railways.*

The grades of staff who are entitled to houses are :

a) Operating staff : inspectors, stationmasters of all grades, pointsmen and telegraphists;

b) Permanent way staff : district engineers, district superintendents, foremen gangers, permanent way inspectors, and crossing keepers;

c) Traction staff : shop and shed superintendents.

Operating staff are housed in the stations, and permanent way and traction staff near stations or their place of work.

4. LUXEMBURG : *Luxemburg Railways.*

Housing accommodation is normally provided near the place of work.

Accommodation can be divided into the following categories according to its purpose :

a) Accommodation for Operating Staff in the stations;

b) Accommodation for Rolling Stock and Traction staff near sheds and depots;

c) Housing estates for staff of the three above mentioned departments : Working, Rolling Stock, Permanent Way and Buildings;

d) Houses for crossing-keepers.

Houses are built for all grades of staff; they are only allocated to employees entitled to them for service reasons.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

In allocating accommodation to the staff, employees are divided into three categories :

1. — Employees who must live in certain places; housed rent free;

2. — Employees whom it is to the interest of the Administration to have housed in certain places; they pay a monthly rent of £0.0.6. sterling for each square metre of house space;

3. — Other employees ; these pay £0.1.0 sterling per square metre of house space.

The Administration endeavours to provide accommodation near the place of work.

It is not always possible to reconcile these requirements with building houses in salubrious places. In the case of the first category of employees, the question may be considered as practically solved.

QUESTION 3.

Apart from building houses, has your Administration taken steps to acquire housing accommodation ? Do you run any scheme to assist in the construction of houses and apartments to be let to employees ? If so, please give details.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

No.

2. FRANCE : a) *French National Railways.*

In addition to their building programme, the French National Railways, if needs be, buy property in which to house their staff.

To find accommodation which can be rented directly to employees, information bureaux have been set up in the principal large towns to facilitate finding and renting vacant accommodation. These bureaux are in close touch with the municipal offices and State housing authorities responsible for requisitioning accommodation.

When building can be recommenced on a large scale and the public authorities can grant credits for this purpose, even if only small ones, the help of the building societies will be enlisted through whom more than 6 400 dwellings were rented to employees before the war, or that of the satellite societies or popular housing organisations who in return for the capital invested by the National Railways will reserve a certain number of dwellings for railway staff.

The organisations whom the French National Railways assist in this way to build new dwellings for their staff are allowed great freedom of action in every way.

b) *Madagascar Railways.*

No.

3. GREECE : *State Railways.*

No; those employees entitled to be housed whom for any reason the railway cannot supply with accommodation

are paid a lodging allowance, which varies according to the size of the place in which they work.

4. LUXEMBURG : *Luxemburg Railways.*

No; when service requirements make it necessary, the Railway approaches the Communal Housing Office to get priority in the allocation of private accommodation.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

No details.

QUESTION 4.

Please give the following information regarding the building programme mentioned above : method and conditions of financing, organisation charged with making loans; repayment of capital; average cost per room and per cubic metre of the building; principles on which rents are fixed; any subsidies granted by your Administration or by the State to enable lower rents to be charged; comparison between these rents and those charged by private individuals.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Neither Railway nor State have so far done anything in granting subsidies to compensate for the high rents now charged.

Rents depend on the cost price (usually 3 % is charged), the capacity and situation of the dwelling.

2. FRANCE : a) *French National Railways.*

It is not possible to report in detail the form nor conditions of financing and capital repayment of the loans made, nor to indicate the average cost per room and per cubic metre of building.

The regulations adopted in fixing the rents take into account the nature of the accommodation, the services available in each case, any features which make it more or less desirable, and the rents in force in the locality.

b) *Madagascar Railways.*

This is a very complicated question for Colonial Railways; the cost of building varies from one place to another; the types of building vary according to whether they are intended for Europeans or natives; climatic conditions also vary from one place to another. It can however be stated that before 1939, building costs were lower than in Europe; in 1946 they are the same if not higher. Rents, which are on a monthly basis, vary according to the grade of employee. The lowest grades do not pay any rent.

3. GREECE : *State Railways.*

No details given.

4. LUXEMBURG : *Luxemburg Railways.*

No details.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

Gave no information.

QUESTION 5.

Can employees continue to live in railway houses on retirement? Are the widows and families of deceased employees allowed to remain in occupation? If so, please give details of the provisions made to house employees succeeding those who have retired or died.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Employees housed by the Railway, whether they pay rent or not, must vacate the accommodation when they

retire. A reasonable period of grace is allowed them, as well as to the families of deceased employees to whom the same rule applies.

2. FRANCE : a) *French National Railways.*

Retired employees and those regraded or dismissed must give up accommodation occupied for service reasons to employees actively engaged in railway service. In the same way the widows and families of deceased employees must give up the accommodation on the death of the employee who rented it; a three months period of grace is generally allowed in which to find other accommodation.

b) *Madagascar Railways.*

No. Accommodation is reserved for employees in the active service of the railway.

3. GREECE : *State Railways.*

Retired or transferred employees must vacate accommodation in favour of their successors.

Widows and families of deceased employees have no right to service accommodation and must vacate it within a very short period.

4. LUXEMBURG : *Luxemburg Railways.*

In view of the present shortage of accommodation, employees must give up their homes when they retire.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

Gave no details.

QUESTION 6.

Has the accommodation provided to date by your Administration achieved the object which you had in view ?

Please give details of any new building programmes.

Would you consider the object attained if your Administration was in a position to house every member of the staff ? If so, what considerations have led you to come to such a conclusion ?

ANSWERS.

1. SPAIN : *Spanish National Railways.*

At the present time this Administration's target in building houses has not been reached, owing to the economic resources of the State Railways and present world circumstances. Recently they have begun to carry out a preliminary building programme according to the law passed on the 19th April 1939; this cover the erection of 4 000 dwellings.

The above law provides for the construction of houses not exceeding 100 cubic metres, no space being wasted in corridors and passages, which can accommodate a family of 5, at an average cost of 46 000 Pts. per house, which represents an average rental of 115 Pts, corresponding to a normal income of 19 Pts.

Of the total value, 10 % is deducted as being the value of the site which is supplied by the Railway, 50 % will be lent by the National Savings Institute, and the remaining 40 % by the « Instituto Nacional de la Vivienda » as an interest free loan.

Capital must be repaid over 40 years as follows : for the first 20 years capital repayment and interest at the rate of 3.68 % to the « Instituto Nacional de Prevision », and for the next 20 years repayment of the loan from the « Instituto Nacional de la Vivienda » at the rate of 2 %.

Groups of houses have already been started at Saragossa, Valladolid and Seville; when the present programme has been completed and the results obtained can be estimated, its extension will be considered.

It would be best if the Railway could carry out an intensive building programme in order to house every employee, which would result in better output of work and social and humanitarian benefits.

2. FRANCE : a) *French National Railways.*

In spite of all the efforts made by the National Railways, carrying on the work of the old Compagnies, in building new houses and improving existing houses, it had not been found possible to meet all requirements before the last war starter. During the war as part of a programme which could not be carried out, the National Railways intended to proceed actively with the building of new accommodation.

At the present time, the first task is to repair and build the accommodation damaged or destroyed during the war.

During the last war, the homes of nearly 50 000 employees accommodating 130 000 persons were blitzed; 5 500 dwellings were destroyed (approximately 2/3rd of them in the Nord area), and 11 500 damaged of those belonging to the National Railways. More than 11 000 of them had been repaired by the beginning of 1947.

In addition new accommodation must be built to provide comfortable and hygienic homes for all the staff.

In allocating the funds which can be devoted to building new homes, the National Railways are taking the urgency of these requirements into account, especially the needs of places devastated by the war, or those railway centres where the lack of private accommodation means that employees have long tiring journeys to make every day.

Building programmes have been drawn up on these lines, the carrying out of which depends on the resources and materials available.

The housing crisis is such that the new homes built to replace those destroyed by the war will not meet essential requirements. The crisis is accentuated by present day economic conditions affecting building and the relative level of rents which do not favour either initiative or private enterprise in building houses. The work of Building Societies which could be relied upon to remedy such a state of affairs is hampered for the same reasons.

The French National Railways could not accommodate all their staff, but they consider it an advantage to be able to house a proportion in the reasonably near future, say some 20 %.

b) *Madagascar Railways.*

The aim will be attained when the Administration is able to house all its employees.

At the present time, all employees in small and medium sized places are housed in accommodation belonging to the Railway; on the other hand in the two main towns served by the Railway (Tananarive and Tamatave), the percentage of employees housed by the Railway (both European and native) is still very low.

3. GREECE : *State Railways.*

This Administration's housing target has been attained.

However as other needs arise owing to an increase in the number ef employees, further accommodation will be built.

The Administration does not intend to provide accommodation for employees who are not entitled thereto.

4. LUXEMBURG : *Luxemburg Railways.*

The target is set by the need for providing suitable accommodation near their place of work for certain employees actively concerned with the operation of the services.

Before the war the Luxemburg Railways owned sufficient accommodation to meet service requirements.

In view of the general shortage of accommodation since the war, it should be stressed that the accommodation available is totally inadequate to meet the demand.

There is no new building programme, apart from the reconstruction of dwellings destroyed owing to the war.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

In its staff housing programme the Administration aims at :

— accommodating all employees of the first and second categories;

— finding accommodation for employees of the third category in places where there are no privately owned houses that staff can rent;

— improving the housing position as far as is possible in those places where the housing crisis is particularly acute.

The target has been practically achieved.

QUESTION 7.

Do any schemes exist to assist employees in purchasing houses for their own occupation ?

If so, please give full details.

Do you think that the above plan meets all reasonable requirements ? Please specify to what extent it might affect a general programme for the provision of railway owned accommodation for all employees requiring it for service reasons ?

Is the fact that employees want to buy their own homes likely to interfer with the regular working of the railway, as for example employees wishing to refuse promotion because it means going to live elsewhere ?

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Up to the present this Administration has no scheme for assisting staff to buy their own homes.

2. FRANCE : a) *French National Railways.*

The French National Railways have agreed to advance to employees whose homes were damaged during the war part of the war damages which the State has agreed to pay.

In addition the French National Railways will make loans to all employees who wish to build, buy, enlarge or repair a home, the amount depending on the cost of building, but not exceeding three times the yearly wage of the employee concerned. Repayment takes place by monthly deductions from wages.

Formalities and consequently costs have been reduced to the minimum. Mortgages are only taken out when a considerable sum is involved.

Technically the National Railways merely satisfy themselves that the property the employee proposes to build or buy is sound and well built, or that extensions or repairs to existing property are justified and well planned. The employee himself is responsible for carrying out the work.

The number of loans made by the former companies to their employees which had still to be paid off at the beginning of 1938 when the National Railways were created, was about 8 000; one year later the figure had already fallen to 4 850.

Taking into account the 1 700 new loans that the French National Railways granted up to the end of 1946, the number of loans now being paid off amount to 2 200, amounting in all to some 58 million francs.

When building can be recommenced

on a large scale, the French National Railways will do everything possible to assist the Building Societies who can grant loans to employees who wish to build homes of their own.

No co-operative societies have been set up for building homes for private ownership, but the National Railways have been studying the statutes of such organisations and are ready to encourage their creation at the opportune moment. The investigation was carried out under the auspices of an organisation known as the Central Housing Commission.

Generally speaking, the railway gives no special facilities to employees for building their own homes, such as cheaper rates of transport, cheap labour and cheap building materials. All they have done is to grant certain small reductions for the transport of relatively small amounts of building materials to put war damaged property into a habitable state of repair. In normal times, the French National Railways occasionally let their employees have small quantities of materials at cost price.

This arrangement has had to be cancelled in view of the fact that the railways themselves are suffering from a serious shortage of materials for maintaining and rebuilding their own installations.

Steps taken to assist employees to own their own homes have not proved an obstacle to the regular working of the railway. To solve the problems that arise when staff are transferred or promoted, the National Railways take the family position of those concerned into account as far as possible. It goes without saying that an employee will only become the owner of his own home if he is assured of a reasonable degree of security regarding his job and place of residence, and the Company does its best to reconcile this with service requirements.

In addition, any employee who is offered promotion at another place can always refuse it if he does not want to move.

b) *Madagascar Railways.*

No. The Colonial Railways must be able to set aside part of the sums budgetted for each year to cover the cost of their housing programme according to the labour and building materials available.

They do not need any loans from Credit Societies or Building Societies.

Generally speaking, there are no houses for sale in the places served by the railways. Moreover special service conditions in the Colonies make it impossible to consider the wishes of employees to live in one place rather than another.

3. GREECE : State Railways.

A law passed in 1930 gave railway employees on the permanent staff of the railway with a minimum of five years service the right to borrow from their Pension fund in proportion to their salaries at a very low rate of interest for buying or building houses in the place of their choice, provided that they joined the co-operative building societies and undertook mutual obligations. These loans are covered by a mortgage on the property to be paid off in 25 years. If the employee retires in the meantime, the sum due to him from the Staff Savings Fund can be used to pay off the remainder of his debt to the Pensions Fund.

The Railway Administration grants no special facilities in this connection.

The number of employees who profited by the above arrangement up to the outbreak of war was approximately 200.

This method of buying or building homes did not prove any obstacle to the regular working of the service.

4. LUXEMBURG : *Luxemburg Railways.*

The Railway Administration is not taking any steps to encourage the building of privately owned homes.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

Part of the resources of the Reserve Funds can be used for building houses to be bought by the staff on the following terms :

— the price of the dwelling is to be the total cost of building it without any interest being charged;

— payment is to be by monthly contributions of not less than 1/5th of the employee's wages;

— exemption from taxes and other charges while the dwelling is being paid for, as well as the dues on the transfer of property;

— while the loan is being paid off, 1 % of the monthly contribution shall be paid for the upkeep of the property;

— retired employees can continue their payments, either by means of their pension or assurance, or from the wages of another member of the family.

The Administration also gives reduced transport rates on building materials to approved employees to facilitate the building of houses for private ownership.

QUESTION 8.

Please supply details concerning the organisation and working of the Department responsible for building, upkeep and management of staff housing accommodation, as well as the working out and putting into effect of measures to encourage such building; likewise the Department concerned with keeping a check on co-operative or other building societies created in order to build houses for sale to employees.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Approved houses are built by tender; the plans, supervision of the work and inspection are the responsiblity of the technical staff of the *Drawing Office of the Way & Works Department;* upkeep and management of housing accommodation is the responsibility of the *Maintenance and Administrative services* of the same Department.

To make sure the property is kept in a good state of repair, every year the Surveyor of the Way and Works Department and the Stationmaster make an inspection during the first fortnight of January and July, during which they draw up a report which records all defects and deterioration which must be made good, together with the causes thereof. If they are due to ordinary wear and tear, the repairs are carried out by the Railway, but if they are due to the negligence or carelessness of the tenant or his family, the latter has to pay for the repairs.

When any accommodation becomes vacant, the Stationmaster has to advise the Surveyor of the Way & Works Department, and they draw up a report after inspecting the premises.

2. FRANCE : a) *French National Railways.*

Dwellings owned by the French National Railways are built through the permanent way and buildings department in each district.

The way the work is to be carried out is detailed by the Central Committee for Social Services on which both the managerial staff of the National Railways and representatives of the staff are included. The Central Housing Commission mentioned above is a special branch responsible for investigating these questions.

Each Regional Management has a

regional housing Commission responsible for investigating the house building and alterations programmes. It is also responsible for carrying out the directions of the Central Commission, looking after the upkeep of the housing estates and other accommodation, and allocating accommodation.

Locally, there are similar organisations to see that empty accommodation is allocated fairly, and to keep the regional Commissions well informed of the housing situation.

Groups of at least 50 dwellings are managed by a housing estate council which assures that the communal facilities provided are properly used and allocates available accommodation according to the instructions received.

b) *Madagascar Railways.*

The building programme is planned and carried out by the Railway Works and Buildings Department, according to available resources as described above. The work is carried out by railway building operatives under permanent way department superintendents; this is cheaper than having the building done by private firms.

3. GREECE : *State Railways.*

There is no Department specially responsible for the building, upkeep and management of houses owned by the staff. The Permanent Way and Buildings Department is responsible for building and upkeep of service accommodation for employees entitled to be housed by the Administration.

4. LUXEMBURG : *Luxemburg Railways.*

Plans for the erection or alteration of buildings are drawn up in the Drawing Office of the Permanent Way & Buildings Department.

The Works Department is responsible for looking after the work and for maintenance.

Accommodation is allocated by the Divisional Letting Office according to service requirements.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

The planning and construction of buildings is the responsibility of the Drawing Office and Building Department, which is charged with drawing up and carrying out supplementary work on the system and in the ports as well as new lines and harbours. This Department has the necessary equipment and labour.

Upkeep and management of accommodation is the responsibility of the Permanent Way & Works Department.

QUESTION 9.

Financial repercussions of the construction and management of the aforementioned houses on the budgets of the Railway Administrations.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

The saving to the Railway due to the law on approved houses is 50 % of the cost of building. Without this saving the financial effects of building and managing this accommodation on the Railway budget would be very great, in view of the high cost of building at the present time, especially as rents must be kept low so that they could never include any interest on the capital expenditure.

2. FRANCE : a) *French National Railways.*

The cost of providing the accommodation which has been built since the creation of the railway corresponds to a total expenditure of some thousand million francs.

Rents are still relatively low and at the present time only cover the cost of upkeep or part of it. In fact, since the

beginning of the last war, the financial charges on the capital invested in building staff accommodation has been entirely supported by the railway.

b) *Madagascar Railways.*

They vary from one year to another, but the investing of capital is certainly an advantage for the Administration.

3. GREECE : *State Railways.*

In view of the way the staff buy their homes, there are no financial repercussions on the State Railway budget.

No information was supplied concerning accommodation owned by the Railway.

4. LUXEMBURG : *Luxemburg Railways.*

The Administration at the present time is making great endeavours to rebuild and improve service accommodation. Since rents have not risen in proportion to the cost of living, the cost of upkeep is considerably in excess of the receipts from rents.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

We are not in a position to arrive at any definite conclusions on the question.

QUESTION 10.

Are any Government or Municipal houses allocated to railway staff in your country ?

ANSWERS.

5. PORTUGAL : *Mozambique Harbour & Railway.*

In 1945 a building estate of small houses was erected in Laurenco Marques for State employees whose monthly wages are less than £25 sterling. Railway employees also are housed in this estate.

— The other Railway Administrations stated that there were no Government nor Municipal dwellings for railway employees in their country.

QUESTION 11.

Please give details of the characteristics of the types of buildings adopted and the methods of building used, the policy followed in grouping houses and the use of available open spaces, as well as details of the policy to be followed in the future.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Investigations into the laying out of single houses or blocks of dwellings showed that it is more economical to build blocks (generally 8.5 to 10 m. [24′ 7 $^{5}/_{16}$″ to 32′ 9 $^{3}/_{4}$″] wide and 10 to 11 m. [32′ 9 $^{3}/_{4}$″ to 36′ 1″] long), in which various component parts and services will be used in common. It was also found that four-storied were the most economical for this type of building. The method of building employed is generally a reinforced concrete framework roofed with wood and tiles.

2. FRANCE : a) *French National Railways.*

Whenever possible staff accommodation is laid out in small or big garden cities, pleasantly situated, wisely planned and conveniently arranged. The staff generally prefer small houses grouped in such estates, rather than isolated houses, or flats in large blocks, except sometimes in the very large towns.

Generally these estates are built near neighbouring towns so that those who live in them will not have to travel too far to their work, or to the shops and schools. Regional styles of architecture are taken into account as far as pos-

sible, so that the railway estates will harmonise with their surroundings.

Squares, open places and gardens are left to give a pleasant aspect and variety in the layout of the different estates.

Typical accommodation consists of four main rooms, in addition to the kitchen and usual domestic offices : a living room and three bedrooms, one for the parents, one for the boys and one for the girls. Very few dwellings only have three rooms. Five and six roomed dwellings are available for large families.

Semi detached houses are preferred, which make it possible to obtain the the greatest convenience with due economy in building. Rows of three or four houses are built very exceptionally.

Near large towns accommodation is sometimes provided in blocks of flats, three stories in height.

b) *Madagascar Railways.*

See Question 4.

3. GREECE : *State Railways.*

Gave no details.

4. LUXEMBURG : *Luxemburg Railways.*

Single-storied buildings are the rule, with one or two appartments in each. Accommodation is also provided in service buildings (station buildings).

Ordinary masonry is used for the outside walls, the roofs are covered with slates or tiles, the floors made of concrete or wood.

Accommodation destroyed during the war is being rebuilt according to the original plans, but is being improved by the addition of bathrooms and W. C.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

Alongside the railway, the dwellings are single-storied houses intended for a single family.

In larger places groups of buidings are erected, often in building estates or several large blocks in the town. There are generally two or four apartments in each block, on one or two storeys, the adjoining land being laid out as a garden.

At Laurenco Marques there is a large ancient two storey building accommodating 65 families. At the present time not more than four families are housed in each building, but in the future the question of building larger blocks will have to be decided as these are more economical, though not advisable in such a hot, damp climate.

The houses are usually built of blocks of cement roofed with fibro-cement tiles. Slabs of concrete have also been used for roofing, but these are not advisable in view of the climatic conditions.

QUESTION 12.

What is the present housing position in your country ? Is there a housing shortage ? Describe the present position, reporting any measures in hand to remedy this shortage. In view of the fact that conditions vary from one country to another, please give the special difficulties met with in your country.

ANSWERS.

1. SPAIN : *Spanish National Railways.*

There is a housing crisis due to the destruction caused by the last war, but both the Government and private individuals are taking all necessary steps to solve the problem, and the situation is already improving.

2. FRANCE : a) *French National Railways.*

The housing shortage is so serious throughout the country that it is seriously affecting the living conditions of the staff and is a serious hindrance to

the operating of the railway. Most of these difficulties are due to the war, the extensive destruction in many towns, and migrations of the population which is only slowly settling down. 450 000 dwellings were entirely destroyed in France, and more than 1 400 000 damaged.

More than 400 new dwellings have been erected by the French National Railways, and the first of some two thousand others are being built. Finally 4 200 temporary homes have been erected. A thousand new homes have been bought and 1 500 rented by the National Railways, while 1 900 others have been put at their disposal by the municipal authorities or requisitioned on their behalf. Finally, out of the 5 900 dwellings belonging to the railway staff damaged during the war, 2 900 have so far been repaired.

The special difficulty in France is the extent of the damage suffered during the last war, which came so soon after the first world war that had already seriously affected the general economy of the country. Owing to the amount of damage suffered, the railway was one of the most sorely tried undertakings.

b) *Madagascar Railways.*

There is a serious housing crisis in the large towns in Madagascar.

There is also a serious shortage of materials and labour.

3. GREECE : *State Railways.*

There is an acute shortage of houses owing to the devastation of the war and evacuation due to the war.

The State has taken various steps to remedy the crisis. The most essential step is to rebuild the houses destroyed.

4. LUXEMBURG : *Luxemburg Railways.*

There is a great shortage of houses owing to the war. About 20 % were destroyed or damaged.

About 95 % of the Railway accommodation has now been made habitable.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

There is a general shortage of houses in the Colony, except in Laurenco Marques. The number of houses has not increased in proportion to the great increase in the population during recent years.

QUESTION 13.

Please indicate the main legislation relating to the construction of low priced and working-class houses, and the advantages derived from such legislation in the case of houses built by your Company and by Organisations for building privately owned houses.

Are there any provisions giving general protection against eviction ? If so, is the Railway excluded from these, owing to the need for housing their staff ?

ANSWERS.

1. SPAIN : *Spanish National Railways.*

No details.

2. FRANCE : a) *French National Railways.*

The railway has not profited directly from the facilities granted by the laws passed between the two wars to encourage the building of individual houses or blocks of apartments. Some of the societies for building low cost houses or granting loans on property have been able to help the staff indirectly.

Remission of fiscal charges for a period of twelve years is being progressively curtailed, so that all new buildings are gradually becoming liable for the full amounts.

Building that has to be carried out by the railway when considered to be

of public utility may involve compulsary acquisition of the necessary sites, but this does not necessarily mean that they will be available quickly at low cost.

b) *Madagascar Railways.*

As the railway system belongs to the Colony, no sewerage rights have to be paid in the case of new buildings.

3. GREECE : *State Railways.*

The chief clauses of the law dealing with the building of low cost houses for individual ownership by employees who are members of railway building co-operative societies are :

No employee can be a member of the co-operative society unless he is on the permanent staff of the railway and has served for at least five years; contributions from wages to pay off loans from the Pensions Fund cannot be more than 3/10th of the wages or 2/5th of the pension; members of a building co-operative or their successors who have not paid their monthly contributions after three months lose all right to the property.

Members of building co-operatives are exempt from taxes on the building for 25 years as well duties on buying and selling, and from dues for the transport of building material.

Tenants are protected from eviction by the law.

There are no special regulations concerning service accommodation provided by the Railway for their staff.

4. LUXEMBURG : *Luxemburg Railways.*

The following laws have been passed:

— Law of the 29th May 1906 on low cost dwellings;

— Law of the 26th April 1939 dealing with the creation of an organisation to grant loans at a low rate of interest for low cost dwellings;

— Government Decree of the 10th January 1945 concerning the fixing of rents.

No special legislation has been passed affecting the railway.

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

Apart from certain fiscal benefits for the first ten years and the granting of loans by certain credit societies, building is not favoured in any way. As regards the protection of tenants, nothing is laid down in the case of railway accommodation.

QUESTION 14.

Please give a brief history of the past building programme achieved either by the Railways or by Societies created to build private houses, indicating :

a) *The number of employees of all grades, employed by the railway;*

b) *Percentage of such employees living in houses belonging to the Railway and those housed in private property. Percentage of employees who are still waiting to be housed by the Company in order to assure the regular working of the railway;*

c) *Total number of buildings, flats and rooms; the latter to be estimated by counting in addition to the rooms in each flat half a room for cellars and half a room for attics, and as one room the whole of the offices (hall, toilet, bath, boxroom, etc.);*

d) *Number of houses belonging to the railway occupied at the present time by railway employees;*

e) *Number of houses belonging to the railway occupied at the present time by retired railway employees or their widows.*

ANSWERS.

1. SPAIN : *Spanish National Railways.*

Altogether there are 21 120 employees

of all grades in the Way and Works Division.

The percentage of employees living in accommodation provided by the Railway to assure the regular working of the services is 34.5 %.

The total number of dwellings owned by the Railway alongside the permanent way, in the stations, or in groups, occupied by employees of the Way & Works Division is 7 294.

No houses are occupied by retired employees or the widows of deceased employees.

2. FRANCE : a) *French National Railways.*

a) Number of employees of all grades on the French National Railways as at the 31st December 1946	402 000
b) Number of those who live:	
— in accommodation owned by the National Rys.	60 000
— in accommodation owned by affiliated organisations . .	6 400
— accommodation rented by the National Rys. or temporarily at their disposal to house employees	3 600
— number of temporary dwellings made available to employees by or through the National Rys.	4 200

Those employees not accommodated in the above dwellings live either in their own homes or in private dwellings rented by them.

The number of employees whom the railway should be able to house to assure the regular working of the services depends on the extent to which private building is undertaken.

Under present circumstances it is not possible to reply to the questions under *c)* and *d)* and supply the information asked for.

The number of dwellings under the heading *e)* is very small and is being reduced as much as possible.

b) *Madagascar Railways.*

Altogether only 15 % of the European staff is housed in railway owned accommodation.

80 % of the native staff is housed by the railway.

The difference in the two percentages is explained by the fact that in small places where all employees have to be housed, the native staff predominates. Accommodation for Europeans contains 3, 4 or 5 rooms. Native accommodation contains 1, 2 or 3 rooms according to the grade of the employee and the size of his family.

No accommodation is occupied by retired employees or the widows of deceased employees.

3. GREECE : *State Railways.*

The railway staff numbers 6 291.

The number of employees living in accommodation owned by the railway amounts to 765, and the number of those entitled to be housed who have therefore to be paid a lodging allowance amounts to 642. No accommodation is occupied by retired employees or widows of deceased employees.

4. LUXEMBURG : *Luxemburg Railways.*

— Number of staff of all grades	5 122
— Percentage of staff housed by the railway	7 %
— Total number of buildings providing accommodation . .	317
— Total number of dwellings	380
— Total number of rooms .	2 371
— Distribution :	
Buildings with 1 to 3 apartments	304
Buildings with 3 to 4 apartments	13
Buildings with more than 4 apartments	none

— Number of dwellings belonging to the Railway occupied by railway employees 352
— Number of dwellings occupied by retired employees and widows of deceased employees 5

5. PORTUGAL : *Mozambique Harbour and Railway Company.*

The number of employees is 1 722, consisting of :

481 first grade
246 second grade
995 third grade

Total : 1 722

This does not include temporary labourers of whom there are about 200, nor native staff which amounts to approximately 6 500.

Number of employees housed in railway accommodation 482, of which

394 are of the first grade
65 are of the second grade
23 are of the third grade

Total : 482

Percentage :

First grade . . . 85 %
Second grade . . . 25 %
Third grade . . . 2 %
Total . . . 27 %

Dwellings built by the Administrations :

No. of buildings.			*No. of dwellings.*	*No. of rooms.*
Large blocks.	*Small blocks.*	*Detached houses.*		
2	—	—	73	456
—	49	—	136	604
—	—	299	299	1 400
2	49	299	508	2 460

No. of dwellings occupied by employees 482
No. of dwellings being repaired 22
No. of dwellings in too bad a state of repair to be lived in 4

Total 508

No accommodation is occupied by retired employees or the widows of deceased employees.

* * *

Conclusions.

It will be seen from the information supplied that the above Administrations are in a very similar position to those covered by the main report, and consequently the general considerations given in the chapter « Summary of the replies received from the Railway Administrations » also apply to these 7 Administrations.

The following special points may also be mentioned concerning these Administrations :

Question 2. — In Mozambique, it is not always possible to reconcile the need for supplying accommodation near the place of work with the necessity for housing the staff in salubrious places.

In Spain, several stations in isolated positions are provided with rooms for employees who have to carry out any long jobs on the spot.

Question 3. — The French National Railways have encouraged the creation of special societies affiliated to the Railways through whom more than 6 400 homes were rented to employees before the war.

Several Administrations are endeavouring to meet the housing requirements of their staff by other means. On the Greek State Railways for example employees entitled to accommodation for whom no accommodation is available, are paid a lodging allowance by the railway, and the Luxemburg Railways when service requirements make it necessary get into touch with the Communal Housing Autorities to obtain priority in the allocation of private accommodation; the French National Railways have instituted and organised information bureaux in the principal towns for the same purpose which are in constant contact with the municipal and State housing authorities authorised to requisition property.

Question 4. — In Spain, the preliminary housing programme for the construction of houses under the law passed on the 19th April 1939 is now being carried out.

The approximate average cost of a home for a family of 5 persons of 100 cubic metres (3 531 cu. ft.) planned on space saving lines with only the strictly necessary corridors or passages is estimated to be 46 000 Pts. representing an average monthly rent of 115 Pts.

On the Madagascar Railways the amount deducted for rent from the monthly salaries of employees varies according to the grade of the employee. The lowest grades of staff do not pay any rent.

Question 7. — Amongst the Administrations who have encouraged the building of dwellings for private ownership mention must be made of :

— The French National Railways who, in addition to the 8 000 loans agreed by the former Companies of which they are composed, up to the end of 1946 had granted 1 700 new loans. However, as a general rule, no special facilities are given, such as reduced transport rates, cheap labour or cheap materials; they have merely given small reductions on the transport of relatively small quantities of materials needed to repair dwellings damaged during the war.

— The Greek State Railways who up to the outbreak of war had granted 200 mortgage loans repayable over 25 years, according to the law passed in 1930, giving permanent railway staff with a minimum of five years service the right to borrow from the Pensions Fund amounts proportional to their wages at a very low rate of interest to enable them to buy or build houses, provided that such employees joined a co-operative building society.

Question 8. — On the Spanish Railways in order to make sure that all houses are kept in a good state of repair, an inspection is made every year during the first fortnight of January and July by the Surveyor of the Way & Works Department and the stationmaster who draw up a report detailing all defects and damage which must be repaired together with the cause thereof.

On the French Railways, amongst the organisations responsible for upkeep, mention must be made of housing estate committees which look after those where there are at least 50 dwellings, and are responible for the proper use of communal equipment and the allocation of accommodation according to the regulations in force.

Question 9. — On the Spanish National Railways, thanks to the great savings made by the application of the law on approved houses, the financial repercussions of building housing accommodation on the railway budget are very limited.

Question 14. — The following

Railway Administration.	*Total No. of staff.*	*Percentage of employees.*		
		In railway owned accommodation.	*In privately owned accommodation.*	*Still to be housed*
1. *Spain.*				
Spanish National Railways	21 210	34.5 %	—	30
2. *France.*				
a) French National Railways	402 000	18.4 %	2.3 %	2
b) Madagascar Railways		15 % of European & 80 % of native staff.	—	85 % Europ & 20 of nat staf
3. *Greece.*				
State Railways	6 291	12.2 %	3.2 %	10
4. *Luxemburg.*				
Luxemburg Railways	5 122	7 %	—	
5. *Portugal.*				
Mozambique Harbour & Railway	1 722	27 %		Aim n achiev

(1) No indication of way remaining accommodation is utilised.

(3) See note (3) of similar table in main report.

(5) Of the remaining accommodation : 22 dwellings are being repaired, and 4 cannot be occupied o account of their state of repair.

p the information given in reply to this question :

Railway owned accommodation.					*Privately owned accommodation.*		
f gs.	*No. of dwellings.*	*No. of rooms.* (2)	*Dwellings occupied by staff.*	*Dwellings occupied by retired employees and widows.*	*No. of buildings.*	*No. of dwellings.*	*No. of rooms.* (3)
	7 294		7 294	—	—	—	—
	74 200		Nearly all.	Negligeable No.		9 700	
				—	—	—	—
	765		765	—		200	
	380	2 371	352	5 (1)	—	—	—
	508	2 460	482	— (5)			

[656 .222 .5]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

14th. SESSION (LUCERNE, 1947).

QUESTION III.

As regards passenger traffic, to report on the best policy for the organisation of the train services from the points of view of frequency and composition of trains, to ensure successful transport at the lowest possible cost, whilst giving passengers reasonable facilities.

To consider in turn the cases of steam and electric lines, showing the extent of using steam trains and railcars for the former, and electric motor coaches and electrically driven trains for the latter, on lines with heavy, average, and light traffic, during and outside rush hours of the day.

SUPPLEMENT TO REPORT (*)

by M. LORRIOT,

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The reports by Managements which have reached us after drawing up the general report on Question III confirm the General Conclusion in our report.

I. Remarks of a general nature.

The figures reproduced below, concerning the position of passenger services in Czechoslovakia and Turkey :

	Percentage of passenger-receipts as compared to total receipts.		*Percentage of passenger-cost as compared to total costs.*	
	1938	*1945*	*1938*	*1945*
A) *Countries that took part in hostilities :*				
Czechoslovakia	27 %	65 %	37 %	32 %
B) *Neutral countries :*				
Turkey	31 %	32 %	37 %	24 %

(*) See *Bulletin of the International Railway Congress Association*, No. of January 1947, p. 29/13.

	1926			1935			1938			1945		
	tr.-km.	p.-km.	a.tr.-u.	tr.-km.	p.-km.	a.tr.-u.	tr.-km.	p.-km.	a.tr.-u.	tr.-km.	p.-km.	a.tr.-u.
A) *Countries which took part in the hostilities :*												
Czechoslovakia . .	64 100	9 130	142	90 000	6 350	72	81 600	8 650	105	19 900	7 800	391
Piraeus to Athens Peloponnesus . .	1 400	130	92	1 350	110	84	2 400	170	69	?	?	?
B) *Neutral countries :*												
Turkey				5 400	630	117	7 800	1 200	152	7 700	2 470	320

Train/km. (tr.-km.) : in thousands of km. Passenger/km. (p-km.) : in millions of passengers. Average train user = a.tr.u.

show that the percentage of passenger-costs, as compared to total costs, has also clearly declined in these two countries, when compared to 1938.

Moreover, on considering the evolution of the mileage of passenger trains, of passenger-mileage and of the average passenger train user, we see that even in Turkey the average number of passengers carried by the trains increased very much after 1938 and reached, as in most European countries, very high figures, caused on the one hand by lack of rolling stock and shortage of fuel, and on the other hand by decline of road transport.

II. Revalorisation of passenger rates.

The statement of the marked tendency to a decline in the gold-value of the kilometrical price for 3rd class, dealt with in Chapter II of the General Report on Question III, is confirmed by the present state of affairs in Czechoslovakia, Greece and Turkey. In effect, this gold-value has become particularly low in these countries, whereas the following table shows :

The figures of the gold-values for 1946 show that in the two countries that took part in hostilities there is urgent need for a revalorisation of passenger rates, which fell to a level representing 30 % and even 15 % of the 1913 rates.

III. Mileage of passenger trains. Organisation of services.

Services on main lines are carried out :

in Hungary, by 2 or 3 AR (return services) of fast trains and 2 or 3 AR (return services) of express trains in the day-time,

	1913.	*1938.*	*1946.*
A) *Countries which took part in the hostilities :*			
Czechoslovakia	0.033 from 1 to 400 km. 0.027 from 401 to 600 km. 0.0186 above 600 km.	0.023 from 1 to 250 km. 0.0155 from 251 to 350 km. 0.0078 above 350 km.	0.005
Greece (Piraeus-Athens-Peloponnesus)	0.04	0.014	0.013
B) *Neutral countries :*			
Turkey	Without figuring the gold-value of the 3rd. class kilometrical fare, the Turkish Railways mention that they have done a revalorisation of passenger-fares, but that the index of the increase is still lower than the general increase-index of other prices.		

by 1 AR (return services) of heavy express trains at night.

in Czechoslovakia, passenger traffic is concentrated between 5 a.m. and 10 p.m. in long-distance express trains, local trains in between, and 1 AR of long-distance trains at night.

in Turkey, the public prefers night services on the Edirna-Istanbul-Ankara run and the timetables are worked out to suit the convenience of the public.

These countries favour light fast trains for services during the daytime, especially high powered fast electrical auto-trains or railcars, in order to reduce the running-time to a minimum. The Turkish railways, moreover, charge a supplement as for express trains for travelling on these auto-trains or railcars.

All these countries, except Czechoslovakia, consider they should provide 1st class sleepers, at least for night journeys.

The service on secondary lines is carried out by 1 to 4 AR (return services) of stopping trains, according to requirements, and some runs are performed by railcars having special trailers.

In Czechoslovakia, however, secondary lines are served by at least 3 AR, mostly using railcars having an average seating capacity of 100 seats.

The French Light Railways (Chemins de fer Economiques), which only work secondary lines, use railcars having 50 seats, the service on their lines being carried out by either railcars or mixed passenger & goods trains.

In Hungary : all secondary line services are carried out by mixed passenger & goods trains.

In Turkey : they prefer using mixed passenger & goods trains on such lines, in order to obtain a better output from the motive power.

For suburban lines Hungary and Turkey have an organisation providing trains every 20 to 30 minutes at peak-hours and every 30 to 60 minutes during slack periods; these trains serve all stations and are not restricted to any special areas.

IV. Lightening of passenger coaches.

The following table shows the tare of metal passenger coaches :

	1st. & 2nd. class coaches.	*3rd. class coaches.*
	t.	*t.*
Hungary	44.4 39	44.7 38.8
Czechoslovakia	46.6	45
Turkey	41	41

These countries have followed the same tendency as most European countries have shown, viz. to increase the tare of their coaches. But Hungary also has light bogie carriages, AB of 39 T., C of 38.8 T. and carriages with exles of 39.9 T. for 2nd. class and 31.2 T. for 3rd class, whereas Czechoslovakia has planned bogie coaches built of light materials, the tare being much less than that of the carriages they now have in use.

Those countries that took part in the hostilities also find themselves with a much reduced quantity of rolling stock :

Countries.	*1938.*		*1946.*		*Coefficient of reduction in usable stock.*
	Theoretical stock.	*Usable. stock.*	*Theoretical stock.*	*Usable. stock.*	
Czechoslovakia	12 270	11 336	9 072	7 106	37 %
Piraeus-Athens-Peloponnesus	452	452	56	50	90 %
Turkey		1 067		1 067	

Their plans for the rebuilding of rolling stock tend to the use of light materials, which will permit of a decided reduction in the tare of their coaches.

Turkey, which has maintained its serviceable quantity of rolling stock, finds itself, nevertheless, in difficulties owing to an increase of its passenger traffic and the impossibility of obtaining delivery of new rolling stock from those countries which build it at the present time.

V. Sprcading out peak passenger traffic.

The aforementioned Managements also express their intention of staggering peak-periods to a maximum and to make it obligatory to reserve seats on certain trains. Hungary, Czechoslovakia and Greece (Piraeus-Athens-Peloponnesus) still have to enforce the reserving of seats beforehand on numerous trains. Czechoslovakia may perhaps not restrict access to trains by travellers holding reduced-price tickets, whereas Hungary, Greece and Turkey restrict the use of trains by such travellers.

Their supply of rolling stock is insufficient to cope with peak-traffic. Nevertheless, Turkey can cope with about 15 to 30 % of traffic additional to their regular service.

[385. (09 (.494)]

The Swiss Federal Railways during the war,

by M. Georges DREYER,

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On the 29th. August 1939, when the Swiss Federal Council decreed that the railways should be run under war conditions, the outlook for the country was very sombre. When a war starts, it is hard to foresee how it is going to develop. Like the people in every country, but with even greater concern, the Swiss were asking themselves what the future had in store. Switzerland was lucky enough to be spared from invasion, to be able to maintain her independence and so be spared the general destruction. But there were plenty of alerts, and all during these difficult years, we were living on the very threshold of war.

After June 1941, Switzerland was surrounded on every side by a single belligerant. To troubles of a military and political nature, were added those of an internal economy cut off from all contact with abroad, and a population too large to be self-supporting. Providentially the foresight of the Authorities had led to the accumulation of large stocks before hostilities started, and plans had been made to increase agricultural production and organise a system of rationing which worked very smoothly.

To this aenemic economy obliged to exist in an unnatural self-sufficiency, in spite of the lack of resources of a country completely without raw materials, one third of which is uncultivated, the railway at least added a powerful factor of vitality, by assuring the scrupulously fair distribution of rationed goods, by maintaining the trade of the country, and carrying out in addition to ordinary passenger traffic, the transport of troops.

As from the 2nd. September 1939, a war timetable was introduced over the whole system. The daily train services available to civilians were thereby cut to 56 %, but as early as October 8th., 1939, the usual timetables were restored, with 94 % of the train services available before general mobilisation. The war timetable was again introduced for a brief period from the 11th. May to the 8th. June 1940, owing to the exigencies of military events abroad. It was then superseded by the ordinary timetables until the end of the war.

At first sight, it might therefore seem that the life of the Swiss Railways pursued its normal course during these years which were so terrible for other countries. Certainly, and this seems to be the leading feature of this period, the Swiss Railways proved themselves to be an admirable economic instrument, astonishingly flexible and well disciplined, more than fulfilling all expectations. Besides military transport, in spite of the many military regulations affecting its staff, the railway dealt with a greatly increased civilian traffic, due to the practically complete stopping of all motor traffic, without any appreciable increase in the number of its employees.

This striking factor, however, only

gives a superficial idea of these five years which were marked by many events directly affecting the railways, taught them a lot, and caused them many preoccupations of all sorts. In the following article we have endeavoured to select some of the essential and most characteristic facts from amongst the ample field at our disposal.

I. — The Swiss Railways under military regime and the contribution of the Swiss Federal Railways to the country's war effort.

The introduction of a military regime on the railways at the beginning of September 1939, took place very satisfactorily, the way having been paved by a whole series of systematic measures.

Military transport was carried out on a larger or lesser scale over the whole period of active service from September 1939 to August 1945. More than 100 million soldiers and a million draught animals were transported, without interrupting the ordinary services. The population, it might be said, had no idea of the extent of this traffic, unless during the nine weeks during which the war timetable which cut the civilian services by approximately one half, was in force. For example, 2 200 special military trains were run during a single week in 1944, when important troop movements became necessary owing to the invasion of Normandy and the serious military situation on the northern frontier.

The militarization of the Swiss Railways which were under the orders of the military chief of railways (one of the general managers of the Federal Railways) and divided up into three groups under the orders of heads of groups (the general managers of the arrondissements of the Federal Railways) was therefore a *concrete fact.*

The reality of the war was felt in the same way as by the railways in other countries, without, it is true, entailing the same tragic and irremediable aspects as elsewhere in the countries that suffered such things as invasion, occupation, deportations, and large scale destructions. The country itself was not actually involved in war with all its attendant horrors, but the war was very near, everyone was aware of it, and affected by it, as an immediate possibility. This was shown especially by the following facts :

1. The militarization of the railway staff did not dispense all railway employees from active military service. Many of them were obliged to serve for two months and then for one month annually. The remaining staff, greatly reduced in numbers by this call-up, had to meet the demands not only of the military and civilian traffic, which surpassed all records between 1939 and 1945, but also was subject to many additional obligations enforced by the military regime under which the railways were being run.

2. The railway staff had to cover a great many extraordinary duties necessitated by military needs and the protection of the system :

a) armed guard over the track and installations, particularly bridges and tunnels;

b) special detachments entrusted with the repair of damage to bridges or tunnels, contact lines, destroyed track, etc.

c) formation of detachments for passive defence;

d) shooting practice outside working hours;

e) defence of electrical stations against aircrafts;

3. The work of administration was equally intense. It included in particular :

a) the preparation of the war time-table, which preparation began as far back as 1938;

b) the preparation of operating measures rendered necessary by mobilisation : assembly points, organisation of special trains, policing, according to a plan drawn up a long time in advance;

c) having the necessary rolling stock available, particularly munition and hospital trains, as well as trains for the army command;

d) the establishment and maintenance of a large stock of steam locomotives, in case the electrical equipment or substations were destroyed;

Photo 1. — Interior view of a hospital coach.

e) preparations for the evacuation of the railway (rolling stock and administrative staff) in case of invasion;

f) the creation of a reserve telephone and telegraph system, with the necessary centres;

g) collecting and maintaining important stocks of spares in de-centralised depots to replace any bridges that might

be destroyed; the construction of embarkation sidings for troops and war material; the reparation of contact lines and safety equipment, as well as making good the damage caused by avalanches, landslides and floods in the districts more particularly subjected to these manifestations of nature;

follows : the bombing of the stations at Renens and Bâle in 1940 and Schaffhouse in 1944; the machine-gunning of stations and passenger trains at Moudon and Delemont and the bombing of a viaduct near Egliseau in 1944; and finally the machine gun attack on installations and trains at Chiasso and the heavy bom-

Photo 2. — Air-raid shelter built by de Swiss Federal Railways.

h) the construction of underground shelters in many stations and places and the collection of the material required by the passive defence organisations and special detachments;

i) the black-out of the stations, trains and railway installations; in the case of shunting yards this made the work very difficult.

4. The Swiss Railways were not entirely safe from bombardment by foreign aircraft. There were 27 incidents between 1940 and 1945, several of which were serious and caused a great deal of damage. The chief incidents were as

bardment of the Wolf Station at Bâle in 1945.

5. Finally — another active sign of war — mention must be made of important measures taken by the Swiss Railways to collaborate in Swiss works of charity :

the transport of the wounded, interned and refugees passing through Switzerland;

the transport of children invited to spend some time in Switzerland by the Child Aid Society (100 000 children up to 1946);

the transport of Red Cross parcels for prisoners of war (280 millions tons from 1940 to March 1944), and gifts sent to the International Red Cross Society;

the transport of English and American personnel on leave passing through Switzerland.

The following statistics *for the single year 1945* will give some idea of the extent of this special traffic :

7 150 Allied and German wounded soldiers passing through Switzerland in 24 Swiss Federal hospital trains;

2 700 sick Russian, Polish and Czech civilians and soldiers staying in Switzerland, repatriated in 24 Swiss Federal hospital trains;

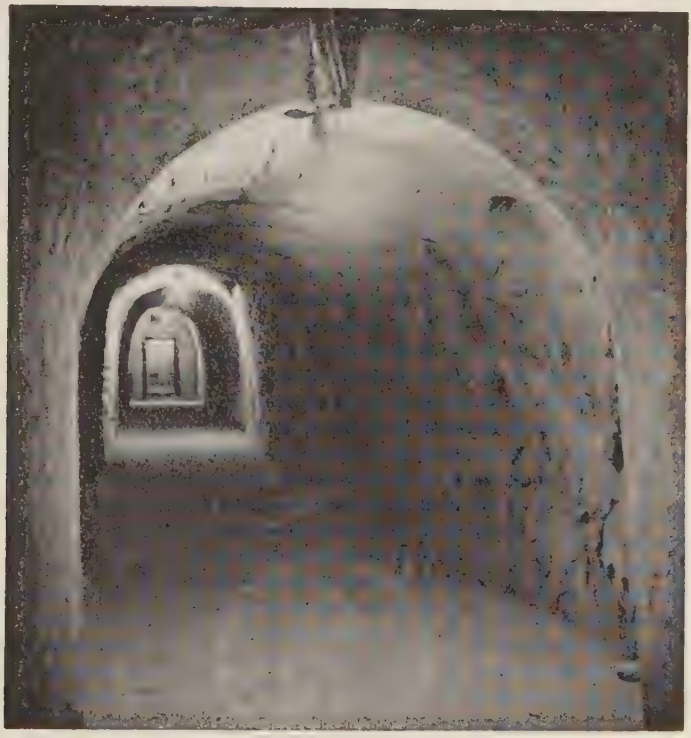

Photo 3. — Passage hewn out of the rock leading to an air-raid shelter built by the Swiss Federal Railways below a large station.

500 English wounded soldiers in transit in two English hospital trains;

2 122 French, Dutch and Belgian citizens with pulmonary diseases arriving by block trains and routed to Swiss treatment stations;

28 628 young French, Belgian, Dutch,

Czech, Austrian and Italian children and Swiss Children living abroad;

321 000 military internees and civilian refugees in transit through Switzerland or travelling in the country;

518 900 unarmed English personnel in transit through Switzerland from Domodossola to Vallorbe or vice-versa;

158 400 American personnel on leave spending their holidays in Switzerland and arriving from Germany or Italy;

To these must be added thousands of refugees and internees who were transported within the country from one internment camp to another, and the fact that

1 230 000 refugees or internees were transported in groups.

For the greater part of the above services, the Swiss Federal Railways had to use their own rolling stock, i.e. from 8 000 to 12 000 seats a day over a certain period.

6. Another characteristic of this period of the war was the necessity for sending abroad a great number of Swiss goods wagons, at the request of foreign railways who were unable to supply the necessary stock, in order to secure supplies for the country and maintain services with certain ports, often very far away, which were still open to Swiss traffic. Between 1940 and the end of 1945, more than 450 000 wagons were run beyond the Swiss frontier in this way, to fetch raw materials essential for the life and work of Switzerland.

7. Finally, the Federal Railways also contributed to the full extent of their capacity in the famous « battle of the fields », in other words the steps taken by the Federal Government to extend the agriculture of the country, according to the Wahlen plan which was adopted in 1940 and increased the arable acreage of the country from 185 000 to 350 000 hectares (458 000 to 865 000 acres) by 1943.

At the end of 1943, 17 000 railway employees were taking part in this work by extending the cultivated land belonging to the Swiss Federal Railways, as well as land rented to them by the Company; in addition, more than 400 employees took voluntarily part in the working parties organised by syndicates, and 270 in obligatory work for the extension of cultivated land.

It may be objected that these details of the effects of the war on the activities of the Swiss Federal Railways are too long drawn out. What do they amount to in fact compared with the upsets, miseries and horrors of war which the railways in occupied countries had to endure, with the noble resistance movement of the railway employees of Belgium, France, Holland and elsewhere ? Very little undoubtedly. Our sole desire, however, was to show that the railways of Switzerland, a neutral country, determined to defend her independence very dearly against any agressor, were in their turn ready, should the need arise, to play their part in the heroic defence of their country. And at any rate they played a part of the greatest importance in helping their country through a difficult time.

Fig. 1. — The Swiss Federal Railways system.

Explanation : ——— Single track. ═══ Double track. ——— Electrifed lines. ——— Steam lines.

II. — The track and electrification of the Swiss Federal Railways.

1. Statistical data.

	1938.	*1945.*
Length of the system	2 912 km. (1 809 miles)	2 901 km. (1 802 miles)
Length of double track lines . .	1 101 km. (684 miles)	1 108 km. (688 miles)
Length of tunnels	165 km. (102 miles)	170 km. (106 miles)
Length of electrified lines . . .	2 139 km. (1 329 miles)	2 509 km. (1 559 miles)
Number of stations	817	821
Number of crossings with roads and public highways :		
Subways and bridges	2 775	2 847
Level crossings	4 300	4 209

2. Difficulties due to the war.

Two essential facts characterize the period of war and to some extent influenced the policy of the railway authorities :

the shortage of building materials and the decrees regarding rationing issued by the Federal Authorities;

the shortage of consumer goods, particularly fuel (coal).

From the beginning of hostilities, very strict regulations on the rationing of goods were issued by the Federal Government. These regulations were tightened up still further during the course of the war. The shortage of cement and iron for civil constructional work obliged the Swiss Federal Railways to return to older methods of construction. Thus the use of wood for the construction of buildings and sheds enabled the consumption of cement and iron to be reduced to the strict minimum. On newly electrified lines, wooden standards were used instead of iron. For retaining walls, concrete was replaced by rubble or stonework.

In January 1943, a decree of the Federal Council imposed an iron tax on all industrial undertakings, in other words the industries affected by this decree had to hand over a given quantity of scrap iron during a certain period. The quota of the Federal Railways was fixed at 35 000 t. (34 447 Engl. tons) over a period of 18 months. Thanks to the thorough collections made in warehouses, stores and shops on the one hand, and to the demolition of superfluous metal structures on the other, the Swiss Federal Railways were able to provide more than the agreed tonnage. Over the whole war period, they collected in this way more than 60 000 tonnes (59 052 Engl. tons) of scrap iron.

The rationing of raw materials resulted in the work of maintaining and renewing the track getting very behindhand, and this work must be caught up with during the next few years. It was only possible to get hold of very small quantities of the materials essential for the renewal of the permanent way. To maintain it in good order, the rate of ballasting was increased, as was the adjusting of the gauge.

On the other hand, the shortage of coal decided the Management to speed up the electrification programme, in spite of the rationing of raw materials (especially the shortage of copper).

3. Electrification of the railway.

The electrification of the Swiss Federal Railways was carried out in several stages. A loan was first granted in 1913 for the Erstfeld-Bellinzona section, but the actual work was only begun in 1916. An electrification programme drawn up in 1918, on account of the first coal crisis, made provision for the electrification of the system in three stages of 10 years, but this programme was modified in various ways during the following years.

The *first stage* immediately after the first world war was the most important; it covered in fact 55 % of the whole system. Owing to the continuing coal shortage and strikes, it was greatly speeded up in 1923, so that it had already been completed by 1928. The original idea had been to electrify the whole system, but a halt was then called in the programme to enable the Management to take stock of the efficiency of the new method of operation and to gain time in order to reduce the stock of locomotives, and the better to adapt the work to the available funds.

The *second stage* began soon after 1930 and affected 16.3 % of the system. The work was carried out more slowly in this case.

Photo 4. — The new viaduct at Berne, opened to traffic in 1941.

The *third stage* which covered 6.4 % of the system was started at the beginning of 1940. The main work in this case was the electrification of the Brünig line, the only narrow gauge line on the Swiss Federal Railways. Once this stage had been completed, the electrification of the railway had reached a stage which enabled the spare stock of steam locomotives estimated as needed for the army as

Present steam lines . . . . . 26 km. (16 miles)
Present electrified lines using direct current . . 7 km. (4 miles)

Entire system : 2 901 km. (1 802 miles). 33 km. = 1.2 %

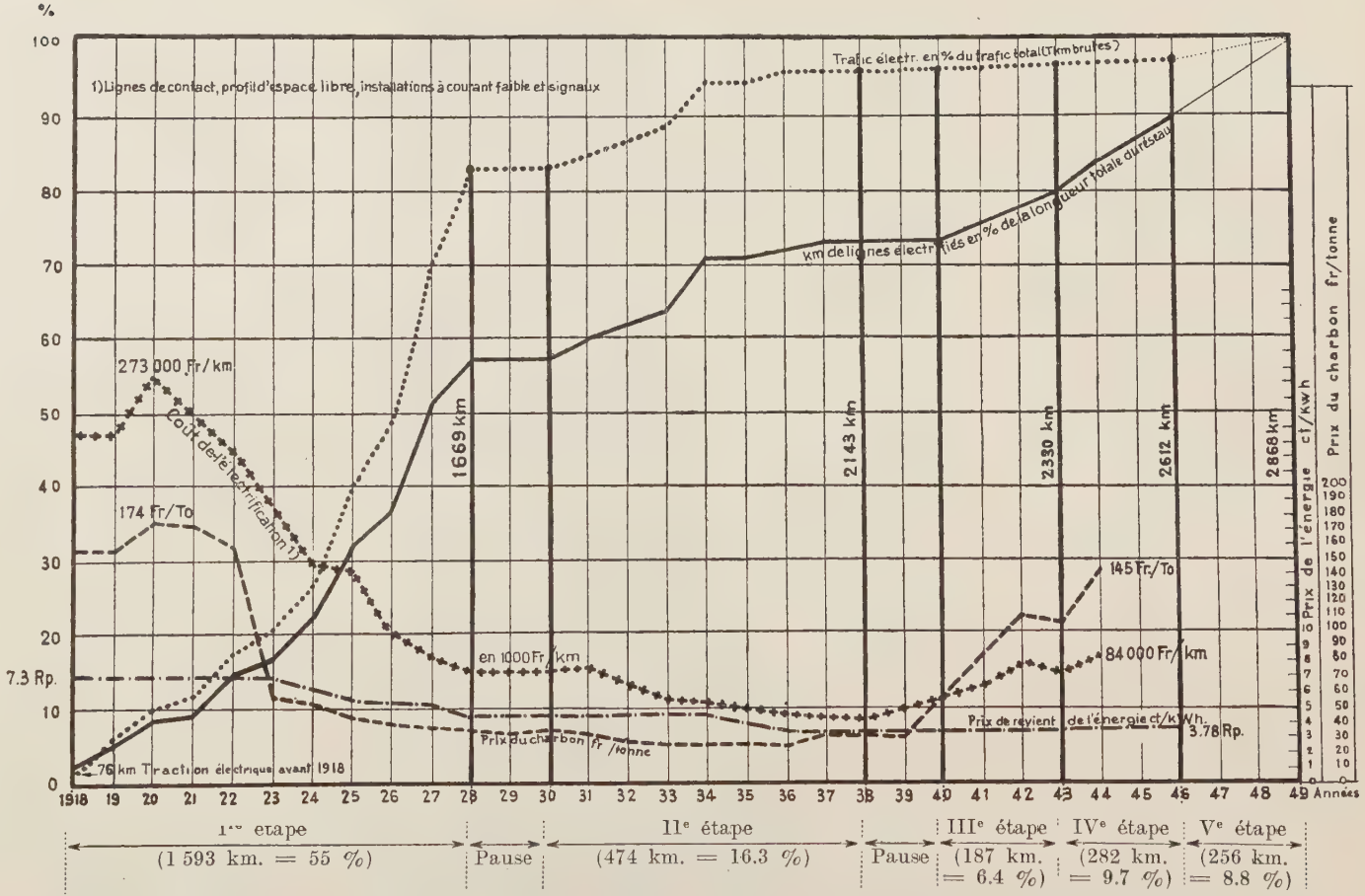

Fig. 2. — Development of the electrification of the Swiss Federal Railways. — Cost of electrification, coal and power.

Explanation of French terms :

Lignes de contact, profil d'espace libre, installations à courant faible et signaux = Contact lines, profile of the clear space, low current installations and signals. — Trafic électr. en % du trafic total (tkm brutes) — Electric traffic as a percentage of the total traffic (gross tkm.) — Km. de lignes électrifiées en % de la longueur totale du réseau = Km. of electrified lines as a percentage of the total length of the system. — 76 km.

well as the staff handling them to be retained.

In 1943, however, the increasing shortage of coal led to further heavy restrictions on the traffic on the steam operated lines. It was then decided to electrify six more lines, forming 9.7 % of the system, in order to help the districts most affected by the new cuts. This was the *fourth stage*. The increase of railway traffic due to the stopping of road transport, even in the case of secondary lines, and the heavy rise in the cost of coal favoured these new electrification schemes, which even the army no longer opposed. It should also be noted that during this fourth stage the greater part of the privately owned railways still operated by steam were also electrified.

At the end of 1945, the *last stage* in the electrification programme was decided upon. This was the electrification of a further 282 km. (175 miles) (out of the total of 2 901 km. [1 802 miles] of lines) still operated by steam. Of these 282 km., 26 km. (16 miles) were small frontier sections operated by foreign Administrations, which temporarily are not taken into account.

The equipment of the electrified lines led to many difficult problems owing to the shortage of materials. As in previous cases, steps were taken to save as much iron, copper and cement as possible.

4. Power stations.

Production and consumption of power.

	1938. *kW-h.*	*1945.* *kW-h.*
Single and three phase current produced in powerhouses belonging to the Swiss Federal Railways	517 002 000	618 343 000
Annual consumption of current required for traction	611 269 000	766 900 000

Sources of current.

Power-houses belonging to the Swiss Federal Rys.	*Minimum annual production in kW-h.*	*Date opened.*
Massaboden	17 000 000	1915
Ritom	60 000 000	1920
Amsteg	252 000 000	1922
Goeschenen	9 500 000	1922
Barberine	65 000 000	1923
Vernayaz	208 000 000	1927
Trient	5 500 000	1928

Jointly owned power-houses.
(Swiss Federal Railways and other concerns.)

Shared in by Swiss Federal Rys. :		
Etzel	76 500 000	1937
Rupperswil - Auenstein	476 000 000	1945

Other power stations :	*kW-h.*
Spiez (Forces motrices bernoises)	7 000 000
Mühleberg (Forces motrices bernoises)	14 000 000
Küblis	37 650 000

At several periods, particularly during the winter of 1942/43 and 1943/44, the production of current in the Swiss Federal Railways' power houses fell to a very low level, owing to the long period of drought, while the consumption of current always continued to increase (increase in traffic). Additional current supplied by other undertakings had then to be used, and very strict measures of economy taken, such as a great reduction in the heating of the trains, the replacing of electric shunting engines by steam engines, and the suppression of some goods trains. It must be added that at certain other times it was the Swiss Federal Railways on the other hand who supplied current to private industry.

In addition, the Swiss Federal Rail-

ways took steps to improve the output of certain power houses. These arrangements, chiefly alterations to the turbines and the conduction of additional water to existing lakes, increased the output by 3 millions kW-h.

Future requirements were carefully considered on the basis of actual facts (extension of the electrification, electrical shunting operations, supply of current to private railways and auxiliary uses) and on probabilities (development of the traffic and extension of electrical operation after the war). The result of this investigation carried out in 1941 showed that 687 millions kW-h. would be the estimated current requirement up to 1950. To cover these future requirements, the Swiss Federal Railways in 1941 decided to build the Rupperswil-Auenstein power house as a joint effort with a group of firms (Entreprises électriques du Nord-Est). The putting into service of this power house increased the current available to the Swiss Federal Railways by about 76 millions kW-h.

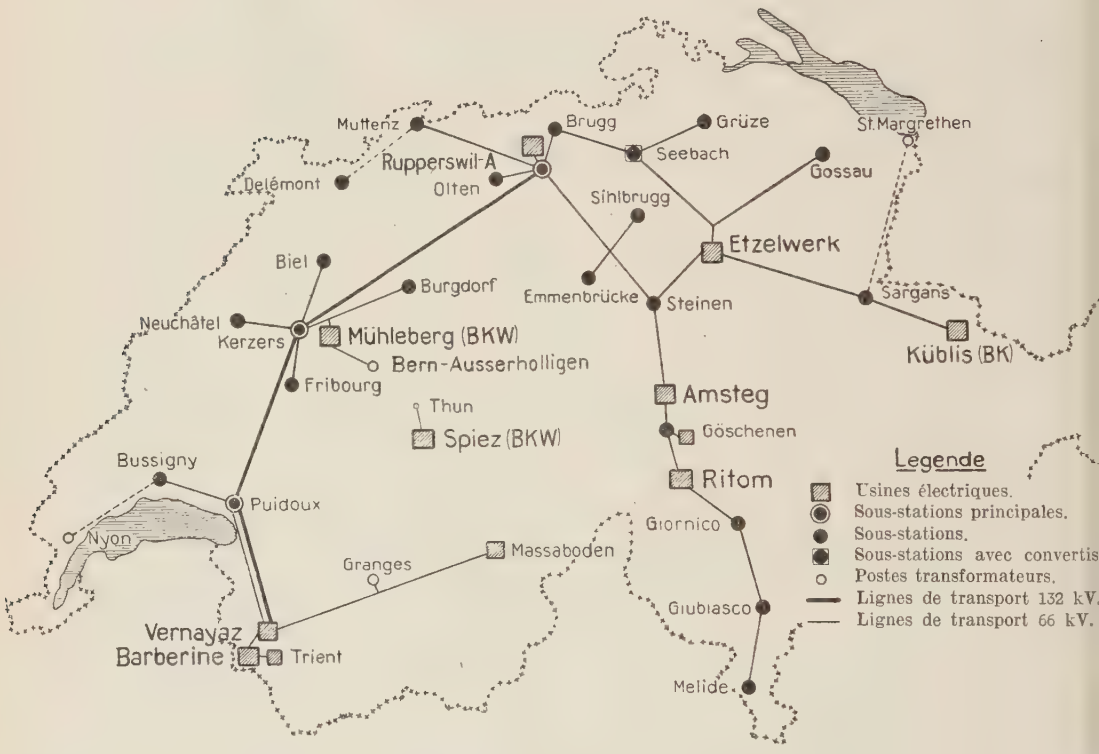

Fig. 3. — Power network of the Swiss Federal Railways.

Explanation of French terms :

Usines électriques = Electric power stations. — Sous-stations principales = Main sub-stations. — Sous-stations = Substations. — Sous-stations avec convertisseur = Substations with convertor. — Postes transformateurs = Transformer substation. — Lignes de transport 132kV = 132 kV power lines. — Lignes de transport 66 kV = 66kV power lines.

5. Other works.

Amongst this mention must be made of the putting into service of new electric interlocking equipment, fitting track magnets to the signals for automatic train control and to the signals at junctions, as well as the introduction of the block system on new sections. These works were carried out in spite of the difficulties occasioned by the rationing of materials.

The last single track sections of the important St. Gothard line were converted to double track, which involved the construction of the Frohnalp tunnel between Brunnen and Sisikon. This tunnel which is 7 km. (4⅓ miles) long was opened to traffic in June 1946.

Finally, the systematic suppresion of level crossings has been continued.

III. — Rolling stock.

The question of rolling stock is one of the gravest problem the Swiss Railways Management has to face.

Statistical data.

	1938.	*1945.*
Electric locomotives	497	543
Steam locomotives	381	348
Other heat engined locomotives	—	3
Passenger railcars	34	35
Passenger coaches standard gauge	3 489	3 407
Passenger coaches narrow gauge	126	117
Brake vans and mail vans	1 044	979
Goods wagons	15 876	18 265
Privately owned goods wagons	1 905	2 436

The construction of rolling stock during the war was influenced, on the one hand by the many factors which hindered all constructional work and, on the other, by the ever increasing urgency of renewing the stock and increasing the numbers. These contradictory influences were due above all to the following causes :

a) the difficulties experienced by suppliers in obtaining the necessary raw materials to complete their orders;

b) the increase in prices, and consequently the difficulty of finding the necessary funds to keep up the renewal programme at the required rhythm [1];

c) the increasing shortage of coal;

d) the fact that the stock was growing old, particularly the passenger coaches, many of which dated from the first years of nationalization (1905-1910) (Fig. 4);

e) the considerable increase in traffic, and the necessity of sending many wagons abroad;

f) the stopping of international passenger traffic.

The guiding principles observed by the Management of the Swiss Federal Railways in the construction of rolling stock may be summed up as follows :

1. Modernisation (lightening of the stock) and renewal of stock were still carried out, but not to the extent that they could have wished :

Construction during the war of an electric locomotive for through trains and heavy goods trains on the St. Gothard line of the Ae4/6 type, four such engines being supplied in 1941 and 12 in 1942.

Designing as far back as 1942, a new light Ae4/4 high speed locomotive, the first of which was only supplied in January 1946.

Construction of new light coaches in steel, but at a rate that in no way corresponded with the renewal requirements.

Construction of new light-weight restaurant-cars in steel.

[1] The index price of coaches increased from 100 to 134 and 148 (according to the type of vehicle) and the index price of wagons from 100 to 160 between 1939 and 1946.

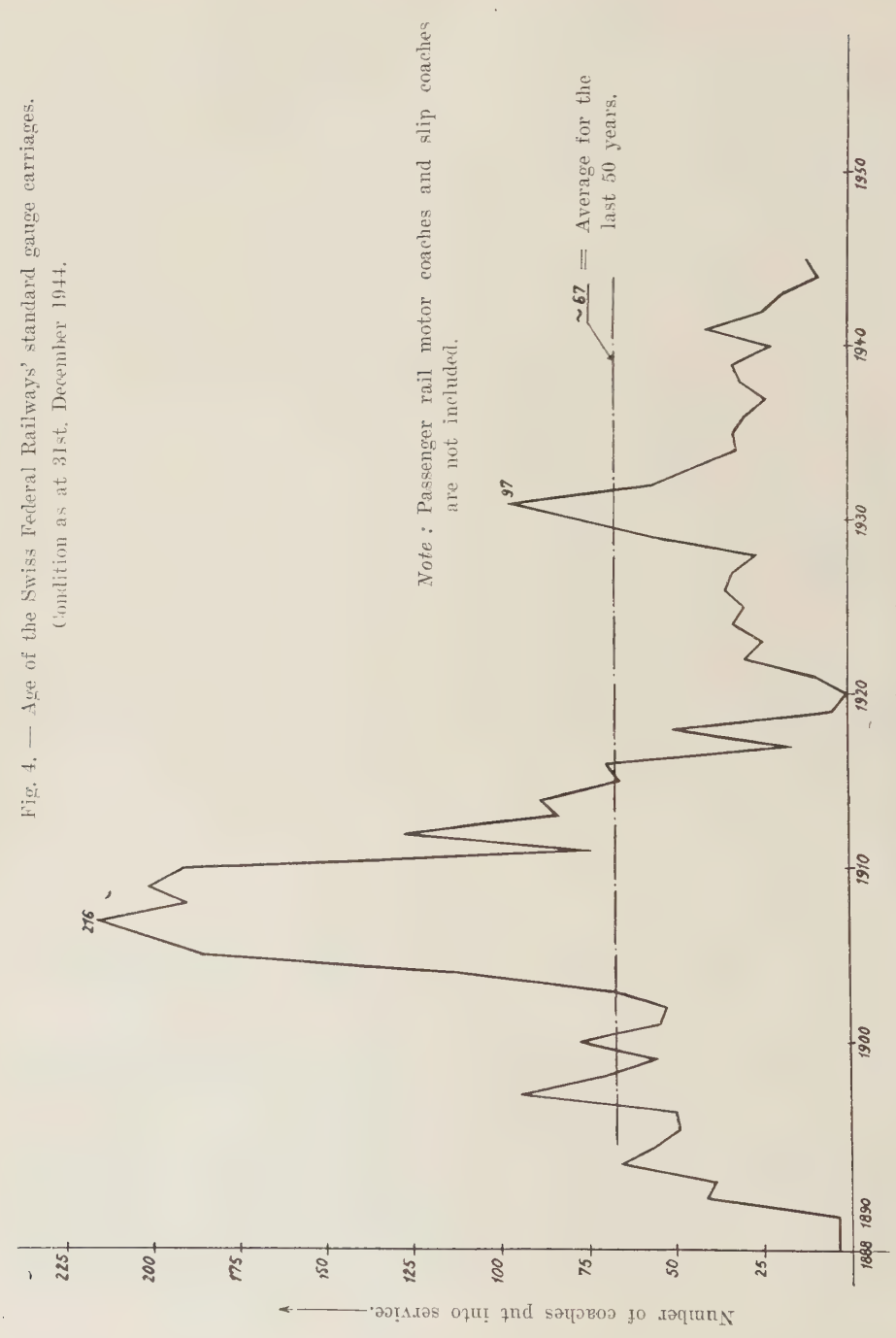
Number of coaches put into service.
Year of putting into service
Note: Passenger rail motor coaches and slip coaches are not included.
~67 = Average for the last 50 years.
276
97
1888 1890 1900 1910 1920 1930 1940 1950
25 50 75 100 125 150 175 200 225

Fig. 4. — Age of the Swiss Federal Railways' standard gauge carriages.
Condition as at 31st. December 1944.

2. In order to combat the shortage of coal, a great many steam shunting engines were replaced by electric locomotives of the Ee3/3 types, and steam traction-engine by electric ones.

3. One series of electric goods locomotives was redesigned in order to increase their speed and power (maximum speed increased from 65 to 75 km. [40 to 46 miles] per hour and power increased from 2 240 to 3 640 H.P.). This would have been done in any case, but was speeded up to meet the requirements of war time traffic.

4. Reduction in the number of RIC coaches built, while on the other hand orders for light coaches for internal services were increased. Construction of light coaches for the narrow gauge Brünig line which had recently been electrified.

5. To meet the shortage of raw materials, many coaches were re-designed; 8-wheeled coaches were brought up to date; old 1st. and 2nd. class coaches were converted into 3rd. class coaches; 6-wheeled coaches altered to 8 wheelers, etc.

6. Considerable increase in the number of goods wagons. Speeding up the construction of certain types of vehicles.

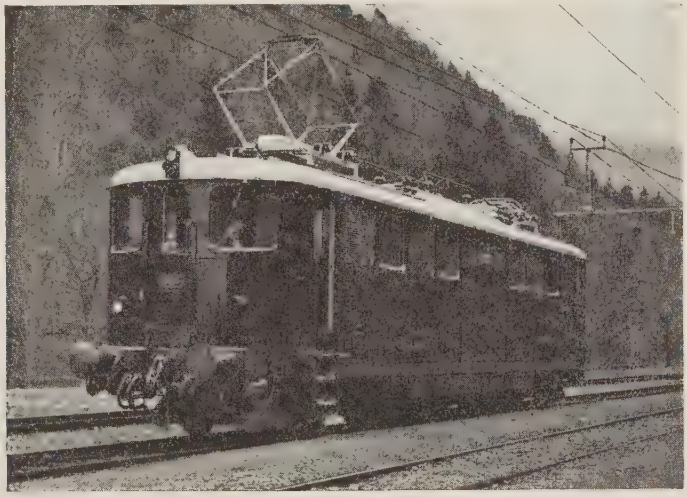

Photo 5. — Series Ae4/6 electric locomotive for hauling through trains and heavy goods trains on the St. Gothard line. Built in 1941. Maximum speed 125 km. (77.671 miles) per hour. Continuous output 5 400 H.P. at a speed of 87 km. (54 miles per hour).

7. Many coaches were re-built, using the frames of old coaches, vans or wagons, and building on new bodies.

The essential features of the post-war programme are the construction of electric locomotives for ordinary services, electric shunting engines and light weight steel coaches.

A long term programme has been drawn up which takes into account the complete electrification of the system in

the near future as well as post-war conditions. The increase in the train services, the return of road motor competition, and the putting into service of light weight steel stock will force the railway to lighten and speed up the trains. For the remaining heavy traffic, the existing stock of heavy locomotives will be sufficient. It is proposed therefore first of all to put into service new light locomotives of the Ae4/4 series. On the other hand, the suppression of steam locomotives on the running lines, will make the use of steam shunting engines more and more irrational; for this reason it has been decided to put into service new electric shunting engines of the Ee3/3 series.

One of the main headaches is still the renewal of the stock of coaches. If the average life of a coach is taken as 36 years, about 95 will have to be replaced every year to make good the rapid aging of this stock. Available resources, however, will not allow renewal to be undertaken on such a liberal scale. For the year 1946, it has been decided to buy 50 light weight steel coaches, 16 of which are 1st. and 2nd. class coaches with side corridors for international traffic, and 4 restaurant-cars for light trains.

Photo 6. — Series Re4/4 light locomotive, with a maximum speed of 125 km. (77.671 miles) per hour. for lines on the level. Built in 1945; this engine was designed during the war.

IV. — **Operating.**

Thanks mainly to electrification, the *timetables* of the main lines did not have

to be drastically cut — except during the two periods when the war timetables were in force. Whereas during the first world war, the number of trains on the Geneva-Lausanne-Berne line had to be reduced to 13, in 1944 the number was the same as in 1938.

The 1940/41 timetables only reduced the passenger train kilometres by 750 000 tr.-km. in comparison with the pre-war timetables, on a total of more than 30 million tr.-km.

The 1941/42 timetable gave some additional services, the result of doubling certain through trains, in order to avoid delays. The 1942/43 timetables once more reduced the total mileage of the passenger trains to about 2 300 km. per day. During the period covered by the 1943/44 timetables very severe cuts were imposed in the case of the steam services : 1 500 tr.-km. daily were cut, i.e. 15 % of the daily mileage. However, for the 1944/45 period, improvements were made in order to relieve congestion, as the existing trains were terribly overcrowded. This new timetable introduced an increase of about 4 150 tr.-km. per day on the electrified lines. This increase in the traffic was made possible by the new electrifications completed in the interim.

Photo 7. — Through train for traffic between towns in the country, of light-weight steel coaches, 2nd. and 3rd. class, and a restaurant-car of similar constructions.

Photo 8. — RIC light-weight coach in steel, 1st. and 2nd. class, series AB⁴ü with side corridor, for international traffic. 42 seats. 28 t. (27.557 English tons). Put into service in 1944.

Photo 9. — Light-weight steel van, series F2u, for internal traffic.

However, to maintain so heavy a civil timetable could only be done by imposing severe restrictions, owing to the considerable increase in traffic, the shortage of rolling stock, and the need for conserving the latter. These measures consisted, for example, of increasing by as much as 10 % the journey time of

Photo 10. — Interior arrangement of a light-weight 2nd. class steel coach for interior traffic. Central corridor. Seat-frames and luggage rack in aluminium.

trains running at a higher maximum speed than 75 km. (46.602 miles) per hour, as well as that of passenger trains on the St. Gothard line, and running the trains necessary for duplicates for excursion traffic during the summer period. The winter sports trains were suppressed for a certain time, then restored to a restricted degree. Special trains also were suspended or greatly restricted, as well as certain little used local trains. A great number of through and stopping

trains were suppressed as well on Sundays and holidays, such trains being those used more especially for carrying workers on working days, as well as certain late trains which were not much used. These restrictions were spread over the whole country as fairly as possible.

In spite of all this, the fundamental structure of the Swiss railway timetables were maintained. The light through trains from one town to another continued to run, and this service was even slightly improved, chiefly by shortening the stopping time at the main stations, and by improving certain connections. The timetables of the newly electrificated lines were considerably improved.

During the whole war period energetic steps had to be taken to make good *delays in the services*, due to the increase in civilian and military traffic, and the great amount of luggage that had to be carried (bicycles and pushcarts). In addition to the steps taken by the operating and traction services and precise instructions issued to the staff (shunting services, boarding and leaving trains, loading and unloading vans, accurate and prompt announcement of delays, very close inspection of the working of the trains, etc.), the public were invited by means of a publicity campaign to assist in fighting delays. The effects of this action were soon felt. In 1942, train delays had already been halved in comparison with the previous year. The public as a whole proved to be well disciplined and understanding. The platforms remained free of access to the public, whether travelling or not, except during certain rush periods when it was found necessary to direct the traffic in the large stations and only allow ticket holders on to the platforms.

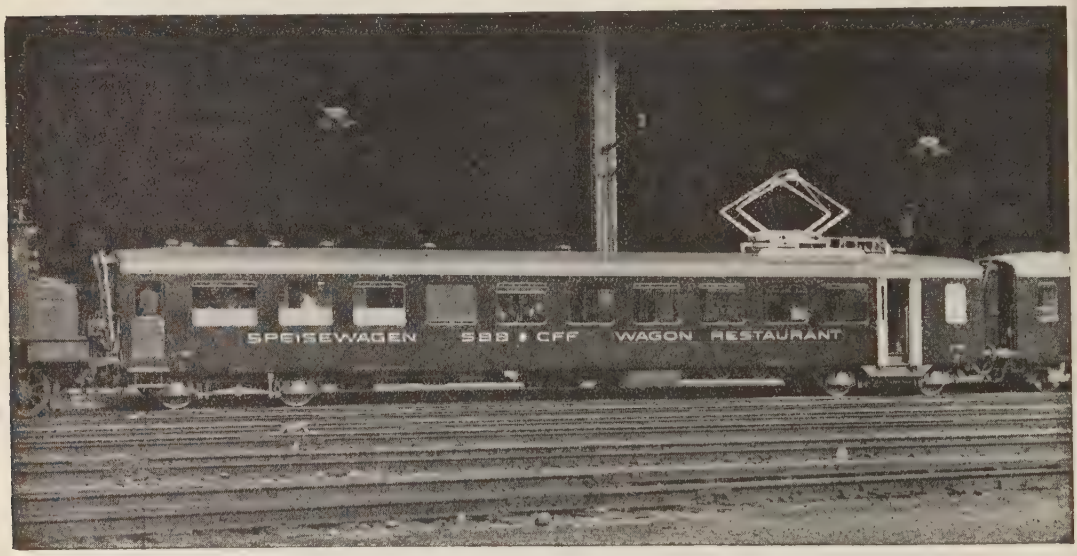

Photo 11. — External view of a new light-weight steel restaurant car. Put into service in 1944.

In the case of *goods traffic*, the great trouble was, as everywhere, the shortage of wagons. This shortage was increased in spite of the increase in the number of wagons, by the necessity for the Swiss Federal Railways to use their own rolling stock for traffic from abroad, since the consigning railways were no longer able to provide wagons to carry the goods. The turn-round of wagons was therefore speeded up by reducing the time taken for unloading and loading from 8 to 6 hours; by keeping the offices open from 6 a.m. to 8 p.m. continuously; by reducing the delays at frontier stations from 5 to 3 hours; by introducing night work and Sunday work for consignments from certain important undertakings; by only allowing cattle to be carried two days a week, and by a publicity campaign by means of posters, circulars, and stamps (Fig. 5).

Photo 12. — Interior arrangement of new light-weight steel restaurant-car.

Finally, another cause of complications was the great amount of parcels traffic, the transport of which at certain periods required as many as 3 600 wagons a day. This state of affairs led the Management to send short distance parcels traffic by road around the main traffic centres in Berne, Zurich, Lucerne and Bâle. These

Photo 13. — 2nd. class panoramic carriage used on the Brünig line. Built in 1939.

Photo 14. — Light-weight 2nd. and 3rd. class narrow gauge steel coach for the Brünig line.

experiments, the result of special circumstances, were intended to free rolling stock to enable goods of vital importance to be brought in from abroad. They also gave a valuable clue to the relations between rail and road.

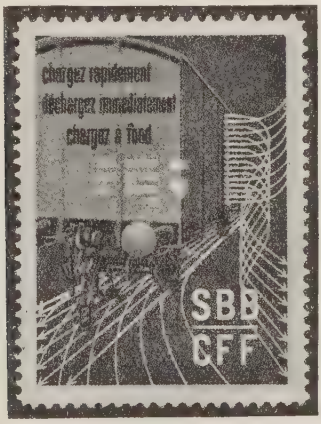

Figure 5.

V. — Traffic and rates.

1. Services and receipts.

An examination of the statistics relating to the train mileage shows that this remained more or less static during the whole period of the war. Any fluctuations were insignificant.

The case is very different however as regards statistics relating to the traffic, which show very great variations compared with the pre-war figures. In the case of *passenger traffic* the number of persons carried in fact increased from 113 million in 1938 to 189 million in 1944 and 204 million in 1945. The increase in 1944 was 70 % and in 1945 84 % compared with the average for the years from 1934 to 1938. This increase covered both ordinary passengers and professional traffic (employees and workmen holding season tickets).

The number of second class passengers in particular increased very markedly. This traffic, which only amounted to 3.61 % of the total traffic in 1938 when 4 million passengers were carried, was 6.05 % of the total traffic in 1945 when 12.4 million passengers were carried. It corresponds to a certain degree to the considerable increase in the number of general season ticket holders, the number of which had no doubt reached its ceiling. Whereas the number of general season-ticket holders in 1938 (2nd. and 3rd. class) was only 2.41 % of the total traffic, the proportion had increased to 4.15 % in 1945, and was constantly increasing. In 1938, 634 000 passengers bought a general 2nd. class season ticket; in 1945, the figure had reached 4 million.

This one example shows how the traffic had changed during the war. The great reduction in motor traffic is partly responsible for this phenomena. The number of tourist coaches and cars which amounted to 76 304 in Switzerland in 1938 had fallen to 17 019 in 1941, when it was at its lowest level, though there was a very slight increase in the following years.

This new and provisional change of affairs, which gave the railways a temporary transport monopoly only partly explains the increase in the traffic, however. This was also due to the great number of soldiers travelling on transport vouchers (at military rates) and soldiers on leave (half fare). Finally, there is no doubt that there was a much greater urge to travel among the population. The improvement of social conditions in the working and agricultural classes was the cause of this.

Whereas before the war, the average number of persons carried daily was 300 000, this figure increased to 560 000

in 1945 (more than 13 % of the total population of the country), while the average number of seats available was only 220 000. The average occupation of seats which was 25 % before the war increased to 35 %. It was very often 100 % on the main lines, especially in the case of the light through trains.

On the other hand, foreign passenger traffic which had already fallen off very considerably during the last few years before the war, disappeared almost completely. There were still 1.43 million foreign visitors to Switzerland in 1938, but this number fell to 90 000 in 1943.

The *passenger traffic receipts* followed a similar curve. Whereas they had fallen to 131.91 million in 1938, they never stopped increasing until they reached 254.3 million in 1945. Even in 1930, the most profitable pre-war year from the point of view of receipts, they only amounted to 159 million. The increase followed the progression given below :

Photo 14b. — Light locomotive and light-weight steel coach for the narrow gauge Brünig line.

	Increase over the previous year in millions of Swiss francs.	*Percentage.*	*Average receipts per passenger in Swiss francs.*
1939	1.73	1.3	1.12
1940	2.58	1.9	1.09
1941	25.40	18.6	1.13
1942	15.19	9.4	1.11
1943	16.87	9.5	1.09
1944	28.89	14.9	1.17

In the case of *goods traffic*, the situation was very different. The movement of goods, which reached a new low level in 1938 owing to the effects of widespread uncertainty (decrease in imports, exports and goods in transit), showed maintained at 238.72 million francs. In 1945, however, for the first time in the records of the Federal Railways, the receipts from the passenger services were greater than those from the goods traffic.

The considerable reduction in the im-

Photo 15. — Twin electric locomotive of the St. Gothard line. 12 000 H.P. Maximum speed 110 km. (68 miles) per hour.

signs of recovery in 1939. The increase continued up to 1942 (decrease in road traffic, intensification of interior traffic), after which it fell off again until the end of the war (considerable decrease in commercial relations with other countries, as well as in through traffic).

Receipts followed the same course. After reaching the maximum figure of 278.42 million francs in 1941, they fell to 268.32 million francs in 1943 and 262.96 million francs in 1944. In 1945, though the volume of goods traffic was still falling slightly, the receipts did not fall off to the same extent, and were port and export traffic would have had even more serious effects upon the goods traffic if it had not been compensated in part by the amount of military traffic, which was extremely heavy, and the transport of goods of high value at high rates within the country itself was greater than before the war.

	Tonnage carried in millions of tonnes.	*Receipts in millions of francs.*
1938	14.2	175.7
1939	17.3	214.2
1940	20.4	247.8
1941	23.5	278.4
1942	22.6	275.6
1943	20.9	268.3
1944	18.3	263.0
1945	13.4	238.7

2. Rates.

a) *Increase in rates.*

The increase in the traffic receipts since the beginning of the war did not however lead to a similar improvement in the operating results. In view of the constantly increasing cost of operation common to all public transport undertakings, the latter were already considering an increase of their transport charges in 1941. The Federal Railways expressly asked for this to be done in 1943. The Federal Council, which at first hesitated to allow such an increase owing to its effects on the general level of prices, decided by a decree dated the 24th. December, 1943, to authorise the railways to charge war surcharges, which would increase the standard rates by 20 % at the maximum in the case of passenger traffic and 10 % maximum in the case of the transport of luggage, express parcels, livestock and goods. These increases only came into effect on the 1st. April 1944.

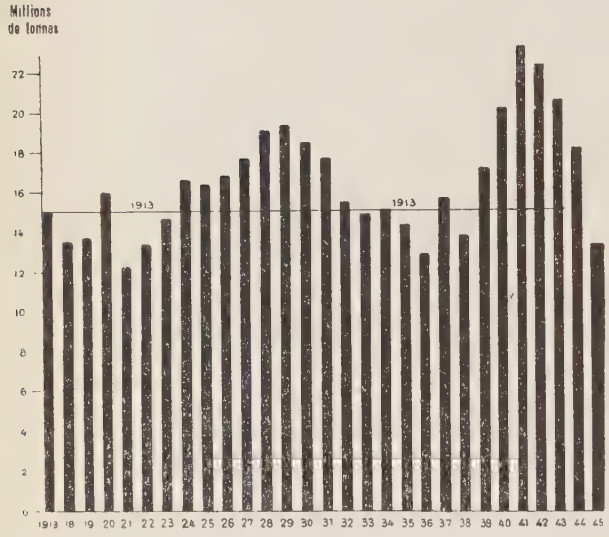

Fig. 6. — Diagram of the total goods traffic 1913 to 1945.

It should be noted however that these additions were not applied uniformly. In the case of passenger traffic, return tickets which are the most widely used were only increased by 10 %. In the case of long distance travel, the additional charge remains constant, so that the percentage of increase decreases as the distance increases. Family tickets are exempt. The price of season tickets was only increased very slightly, and only in the case of short distance seasons.

In addition, the revenue from the increases, according to the decree of the Federal Council, was to be set aside for a distinct purpose. The Federal Railways were to devote it to decreasing their indebtedness. Private undertakings had to give up 20 % of the receipts received from these increases to a common fund intended to make good the deficits of those undertakings the hardest hit by the prevailing economic situation (steam operated railways, navigation companies).

The increase in the rates in 1944 was therefore relatively small. In actual fact, its effects on the general level of prices was negligeable (½ %).

b) *Passenger tariffs.*

The chief innovations made in the rates were as follows :

1. As from the 1st. January 1943 the distance supplements (from 20 to 100 p. c.), still charged in the case of pas-

senger traffic on certain mountain sections (for example the St. Gothard line, between Erstfeld and Bodio; the Simplon line between Brigue and Iselle) were suppressed; which meant an average annual decrease in the receipts of about 3.2 millions.

2. The age up to which infants were carried free was raised from 4 to 6 years, and the age limits for half fares was increased from 12 to 16 years after the 1st. April 1944.

3. Transport at half fares of the labour required to carry out the programme for the increased agricultural production of the country to assure the food situation, as well as of the labour employed in constructional work of national interest (cost of transport met by the Confederation).

4. Introduction, as from 1940, of a holiday season ticket intended to encourage travel in the country.

These holiday tickets, issued on payment of a basic sum which at the present time is 11 francs, entitle the holder to transport at half fare from his home to the place where he is going to stay, as well as five excursion tickets at half price from this place or an intermediate station at least 50 km. (31 miles) from the starting place. These tickets are valid for 10 days, but the period of validity can be extended by 7, 14, 21 or 28 days on payment of an additional 4 francs, the holder receives a card available for three additional journeys at half fare from the place where he is staying or an intermediate station. In addition, the last 50 km. of the return journey cannot be travelled sooner than the 5th. day after the beginning of the journey (including the day of departure). The half price tickets to which holders of these holiday tickets are entitled are issued for each class, with or without extra charge for through trains. Finally, it must be added that the greater number of private railways and mountain lines are sharing in the issue of these tickets.

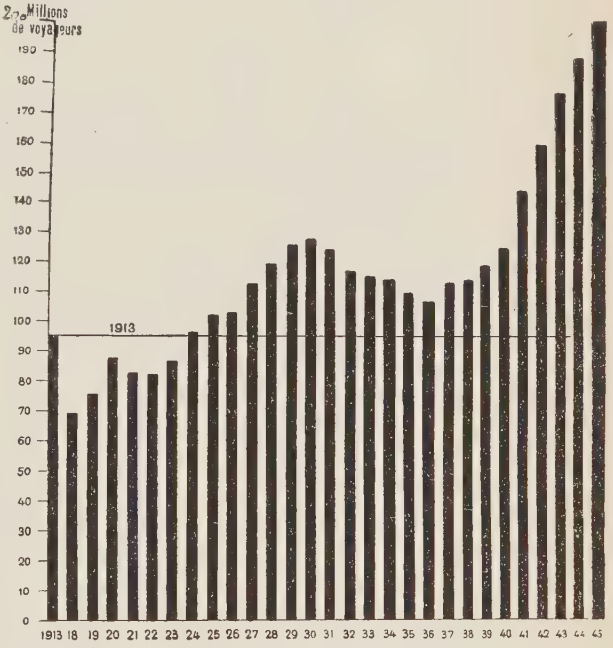

Fig. 7. — Diagram of the total passenger traffic — 1913 to 1945.

Holiday tickets are issued every year during the winter and summer during a given period. The popularity of such tickets has continually increased; their sales have now reached the following figures :

	Holiday Season tickets.	*Supplementary cards.*
Summer 1940 (1st. April to 31st. October)	130 204	100 366
Winter 1940/41 (15th. December to 31st. March) . . .	50 259	35 637
Summer 1941 (1st. April to 31st. October)	266 404	203 739
Winter 1941/42 (20th. December to 31st. March) . . .	69 851	46 782
Summer 1942 (1st. April to 31st. October)	305 927	216 977
Winter 1942/43 (29th. December to 31st. March) . . .	74 011	49 604
Summer 1943 (1st. April to 31st. October)	313 272	227 529
Winter 1943/44 (8th. December to 31st. March)	50 743	33 176
Summer 1944 (1st. April to 31st. October)	320 347	227 077
Winter 1944/45 (15th December to 31st. March) . . .	112 527	55 833
Summer 1945	421 384	313 075
Winter 1945/46	102 555	68 550

c) *Goods tariffs.*

The normal structure of the goods rates has not been modified in any way during the war. The goods classification, which was revised in 1939, was subjected to its first supplement in 1943. As a whole, special rates, granted to certain goods of vital importance to industry or agriculture, have not been altered either, although certain revisions would have been justified. The Swiss Federal Railways wished to contribute, in this way, to the policy of price stabilisation practised by the Federal Authorities. On the other hand, certain special rates introduced to meet the competition of foreign lines have been increased or suppressed because there was no longer any reason for them.

(To be continued.)

[621 .133.3]

Research into the causes of locomotive boiler explosions

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(Revue générale des Chemins de fer, July-August 1945).

The firebox explosions recently reported in France and in England (1) have once again drawn attention to this type of accident which is, fortunately, of rare occurrence.

These mishaps are generally ascribable to accidental lowering of the water level whereby the crown of the firebox is exposed to intense heat and the strength of the metal seriously reduced. Confirmatory evidence is nevertheless sometimes difficult to obtain.

The fractured plates may retain their normal appearance without any trace of oxidation on the water side. Disappearance of the boiler scale, which is a feature of explosions due to overheating, does not constitute sufficient proof in the case of a boiler showing little overall scale deposit. In short, it is at times difficult to prove that the water must have receded from the firebox crown.

Since it is of great importance in such accidents to establish the cause, it may be of interest to describe a method of investigation, which has enabled us to decide with certainty. This is the object of the present note, and provides an interesting example of the application of a laboratory study to a practical problem. (2)

The fireboxes in the locomotives under consideration were fitted with vertical crown stays having rivetted heads as seen in Fig. 1. During the formation of the head A the crushing of the rivetted metal stretches and distorts the grain of the steel, as may be seen under the microscope. The metal is then said to be « cold worked ». If such metal is afterwards heated sufficiently, recrystallisation takes place and alters the appearance of the microstructure.

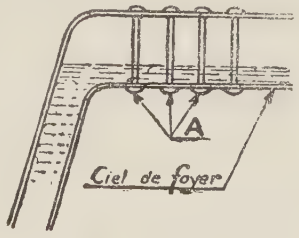

Fig. 1. — Method of supporting firebox crown by rivetted stays.

We therefore considered examining the metal in the heads of stays taken from damaged fireboxes with a view to calling in evidence, if possible, a structural change as proof of the existence of a period of abnormal temperature rise in the firebox crown with eventual drastic overheating.

The following is a summary of our observations :

Figure 2 depicts the appearance of a normal stay in an undamaged boiler and Figure 3 shows in greater detail the grain structure at *a*. This photograph,

(1) The mishap in England was described in an article appearing in « Modern Transport » for Feb. 26th., 1944.

(2) The photographs accompanying this note were prepared in the « Levallois » laboratory of the « S.N.C.F. ».

taken at a magnification of 100, reveals the elongation of the cold worked grains to which reference has been made. This is their normal appearance and it persists in service since the temperature of the firebox crown does not normally exceed 230° to 240° C. (446° to 464° F.).

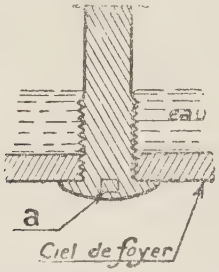

Fig. 2. — Original shape of stayhead, showing location of zone *a* photographed in Fig. 3.

Fig. 3. — Normal microstructure of rivetted head (zone *a* of Fig. 2) showing elongation of cristal grains caused by rivetting. (Magnification : × 100.)

By contrast, the appearance of a stay from a firebox damaged by explosion is seen in Figure 4. The crown has been thrust downwards and the edges of the rivet turned back.

Under microscopical examination the appearance of the metal is totally different from that of the preceding case. Figure 5 (taken at the same magnification as Fig. 3) shows the much smaller grain size of the area *b* marked in Figure 4. The metal *has recrystallised* and there is no sign of distortion or of orientation in any preferred direction. Recrystallisation takes place whenever cold worked metal is strongly heated. The precise temperature and the probable duration of the heating to which this stayhead had been subjected could of course be determined by experiment, but it may safely be said that the firebox crown had been overheated, certainly above 500° C. (932° F.), and that insufficient depth of water over the crown had led to failure.

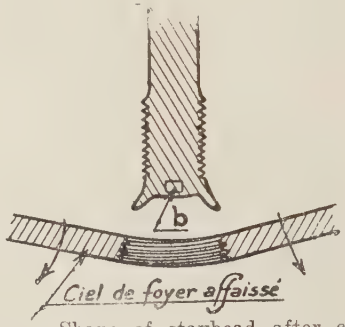

Fig. 4. — Shape of stayhead after collapse of firebox crown, with location of zone *b* seen in Fig. 5.

The structural change in question may be detected in the process of occurrence. Figure 6 is taken from a portion of the damaged stayhead where the temperature rise was only just taking effect. Here are to be seen large, elongated, cold worked grains identical with those of Figure 3 while, around the dark spots (which are slag inclusions) small recrystallised grains similar to those in Figure 5 are commencing to form. The full significance of this photograph (Fig. 6) which, with the preceding ones, was taken in the S.N.C.F. laboratory at Clichy-Levallois, will be apparent to all familiar with the structure of metals. It illustrates the transformation of the metal in the process of annealing and the role played therein by impurities,

which initiate the return to structural equilibrium. In this particular case the material was not mild steel but puddled iron, which is a remarkably soft metal containing numerous slag inclusions. These latter did not play any part in the failure of the firebox but they did serve particularly to promote recrystallisation.

It has been confirmed by the examination of rivetted stays taken from *undamaged* fireboxes that recrystallisation had nowhere occurred and that the microstructure was as shown in Figure 3.

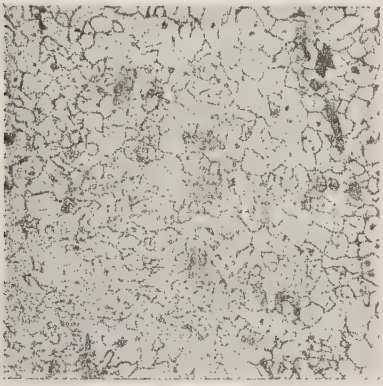

Fig. 5. — Microstructure of zone *b* (Fig. 4) in rivetted head overheated through shortage of water. Very small equi-axed grains formed by recrystallisation (Magnification: × 100).

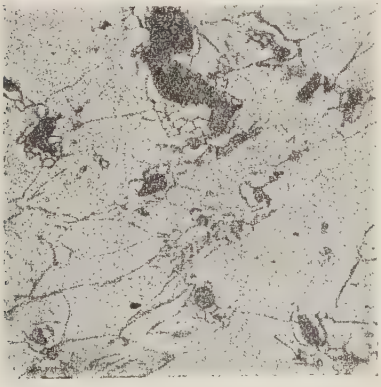

Fig. 6. — Microstructure of rivetted head, overheated through shortage of water, showing early stages of recrystallisation commencing around non-metallic inclusions (black).

The fine grained, recrystallised structure characterised by Figure 5 offers certain proof that the firebox crown has been drastically overheated. Its presence is not however an inevitable feature and it may be that overheating could occur without there being time for structural modification of the stayheads to take place. It has nevertheless been observed in every case of damage that we have had occasion to investigate, and it is essential to remember that, although the absence of recrystallisation proves nothing one way or the other, its presence permits of a positive conclusion being drawn.

CONCLUSION. — The investigation of recent firebox failures caused by severe overheating has led to the recognition of a characteristic feature which, when present, establishes the cause of the mishap beyond all doubt. We refer to the structural transformation of the metal in *the heads of rivetted crown stays,* whereby the *large cold worked crystals* originally present are replaced by *very small ones resulting from the recrystallisation brought about by overheating.*

This feature is not observed in undamaged boilers. Moreover, it may not necessarily be found in damaged boilers, but its presence, when confirmed, justifies the inference that abnormal heating has supervened due to lack of water.

The foregoing study is based upon the particular case of rivetted stays. (Many boilers are fitted with nutted stays, not amenable to investigation of this kind.) Although it is of limited application there appeared to be some justification for describing an interesting means of examination which, under the appropriate conditions, permits the certain recognition of the cause of serious mishap.

[621 .438 (.43)]

Gas turbines for traction purposes.

A summary of German developments.

(The Oil Engine, October 1946)

By the courtesy of the Institution of Mechanical Engineers we here present a précis of a paper entitled « The Development of Gas Turbine Power Plants for Traction Purposes in Germany » by Lt.-Col. R. H. Bright, R.T.R. It is to be discussed in writing.

During the last year of the war (1944-1945) the possibility was seriously considered in Germany of employing gas turbines as power plants for various types of vehicle. The reasons were mainly the hope of increasing the power-to-weight and power-to-volume ratios with a simpler and cheaper construction. Thus it was intended to obtain some power units for traction purposes of greater horse-power than those available at the time, but to use them for the same types of vehicles as those in which petrol and oil engines had been fitted. If a gas turbine was to have any advantage over a petrol-injection engine with an output of about 900 H.P. it was required to give a greater output for the weight and volume, also to confer other advantages by its use.

The other advantages expected were that it should use a fuel of low quality, although it was realized that, in the initial stages of development, that fuel consumption would be considerably higher than in the case of a compression ignition or petrol engine. It was, however, hoped that this would be reduced during later stages by the introduction of a suitable heat exchanger. It was anticipated by the Germans that they would be able to employ this new plant for a variety of land-traction purposes, but owing to their total national mobilization, the most important applications they had in mind were to be for war.

Potential gains.

Simplification in both construction and maintenance when employing a gas turbine instead of a conventional compression ignition or petrol engine must be considered. No radiators or cooling system are required, and lubrication presents a much simpler problem. As against this, a gas turbine of German or Swiss design would be of an awkward shape for installation in any vehicle, other than a railway locomotive in which length is not so important, although there is no reason why the shape should not be made to conform to a considerable extent to any particular requirement. It is most convenient, in the German view, for the whole plant to be in line, but it is obviously not essential.

Air cleaning in a gas turbine presents a different problem from that in a reciprocating engine. The turbine may be expected to accept considerably larger dust particles in greater concentration than can be tolerated by other types of power plant. The precise degree of cleaning has not been established in Germany. The opinion has been expressed by several German engineers who have been working on the project that, provided dust particles of over 0.1 mm. are eliminated, no undue damage will be occasioned to the turbine or compressor. On the other hand experience shows that dust particles of over 0.1 mm. are rarely encountered, so that if this is correct, no air cleaning will be necessary.

Gas turbine units have been accepted as a means of propulsion for military aircraft in service, not only in Germany, but in many other countries; this shows

that a considerable degree of reliability and many advantages may be expected from them. The dimensions of a German design of gas turbine without any heat exchanger as at present envisaged are not much smaller than those of a similar internal-combustion engine of equal capacity, but as it requires no cooling system it permits a considerable economy in space.

A gas turbine designed according to British practice compares favourably as regards volume with a standard reciprocating engine. It is claimed that the cost of materials and labour required to build a turbine works out at about one-third of that for a similar installation incorporating a piston engine, according to present-day production methods. Maintenance should be considerably reduced, and a low-grade fuel can be used. The lowest specific fuel consumption which might be expected from a gas turbine of German design for a vehicle would be between 1.0 and 1.1 lb. per b.h.p.-hr. This figure is at least double what might be expected from a compression ignition or petrol engine, although a gas turbine of British design might do better. By the introduction of a suitable heat exchanger to utilize the exhaust gases, a considerable reduction in fuel consumption should be possible.

The useful output of all internal-combustion engines is fundamentally derived from the difference between the work of expansion and the work of compression. This applies equally to gas turbines, although compression takes place in a separate machine. Compression, in this case, however, absorbs a relatively large part of the work of expansion due to the relatively low temperatures at present employed in gas turbines. The remaining work may be produced in different ways. On the other hand, over and above this limitation (which shows that only 25-40 per cent. of the actual work done can be used externally), without a heat exchanger a great amount of heat is discarded with the exhaust gases. Without a heat exchanger, therefore, a thermal efficiency of only about 16 per cent. may be expected in German practice, and a slightly better figure with British designs.

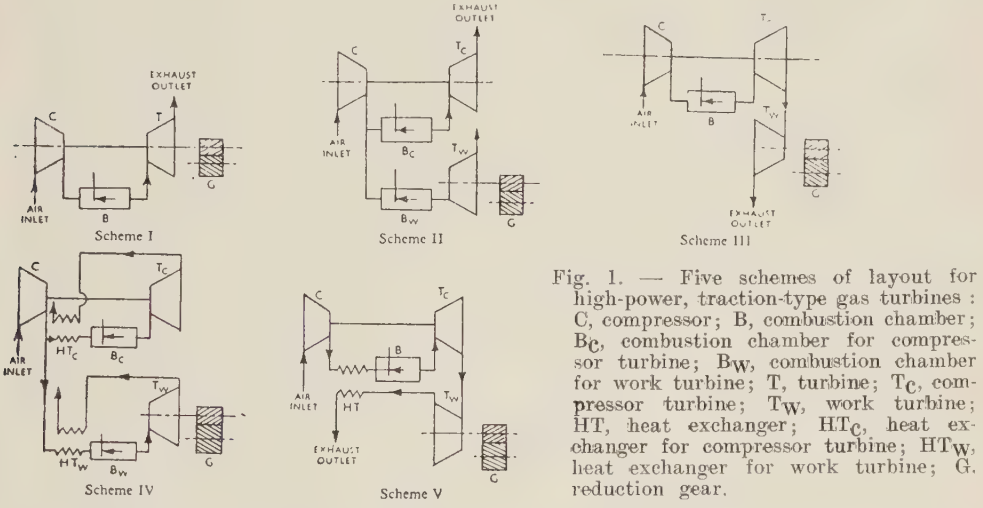

Fig. 1. — Five schemes of layout for high-power, traction-type gas turbines : C, compressor; B, combustion chamber; B_C, combustion chamber for compressor turbine; B_W, combustion chamber for work turbine; T, turbine; T_C, compressor turbine; T_W, work turbine; HT, heat exchanger; HT_C, heat exchanger for compressor turbine; HT_W, heat exchanger for work turbine; G, reduction gear.

Torque and transmission.

For the transmission of the useful work obtained from a gas turbine to the driving wheels of a vehicle, any of the normally accepted transmission systems may be employed. The use of a purely mechanical transmission is usually excluded when only one turbine is employed, because of the unsuitable torque characteristic. Two turbines may, however, be employed to give a torque characteristic which shows considerable advantages over that obtained from a Diesel or petrol engine (Fig. 2). There appear to have been five stages in the German development of a high-powered unit for traction purposes (Fig. 1).

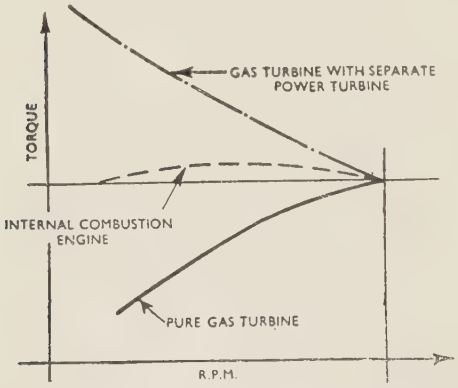

Fig. 2. — Comparison of torque curves for various types of power unit.

One of the most difficult problems in connection with the employment of a gas turbine in a vehicle is that of control. In the case of Scheme 1, the actual means of control of the output is comparatively simple as temperature control in the combustion chamber, i.e., fuel regulation, is the only logical course. On the other hand, some device must be employed otherwise the engine will stall. The Germans intended to employ an electrically operated gearbox for this design.

In Scheme 2, the principles governing the control system are somewhat more complicated. The simplest would be to work on the maximum torque curve, merely controlling the output of the work turbine by the temperature in its own combustion chamber, i.e., by fuel control of the work turbine only. The fuel consumption, if this method were employed, would obviously become prohibitive as the primary turbine would be working at full load on maximum fuel consumption all the time. Some form of dual control is, therefore, necessary to control both primary and work turbines, so that the work turbine is operating on its most suitable torque characteristics, having regard to overall fuel consumption. This condition could be obtained by regulating the fuel supply of the work turbine only for minor fluctuations of speed and load, and following this by the regulation of the primary turbine to obtain the most economic fuel consumption for any particular set of conditions of load and speed. To expect the average vehicle driver to use such a system of dual control to the best advantage is not practicable. Some form of automatic linkage must be provided between the control of the two fuel supplies. The Germans did not solve this problem.

Inefficient control.

There is one further method and this is by the control of the air delivered from the compressor to the work turbine by a valve. This is obviously a wasteful method, as it will necessitate the spilling of a proportion of the air normally delivered to the work turbine if the primary turbine is maintained at a constant speed with a constant output of air from the compressor.

As regards control for the remaining layouts, in the case of Scheme 4, the problem is obviously the same as for Scheme 2. For Schemes 3 and 5 no method of control has been considered,

as these designs had never been developed in any detail. It would appear, however, that temperature control in the common combustion chamber would be the only practicable method, and this has the advantage of controlling the output of both turbines and thus reducing automatically the output of the compressor when a smaller torque is required from the work turbine.

The transmission required for any of the schemes incorporating the separate work turbine would be very greatly simplified in comparison with that required for Scheme 1. Owing to the excellent torque characteristic which may be obtained when using a separate work turbine, it is probable that for road operation of any vehicle two gears should be sufficient in a comparatively simple type of gearbox, although it must be remembered that the transmission mechanism on the power-plant side of the gearbox will be expected to transmit a much greater torque than in the case where a normal type of internal-combustion engine is employed. It will be necessary to employ a 10-to-1 reduction immediately after the work turbine in any of the schemes considered in order to reduce the speeds in the transmission to those of normal practice.

Starting requirements.

For the purpose of starting, two electric motors are included in the installation, with a total output of 15 to 20 H.P.; to start the installation it is necessary to raise the speed to 20 to 30 per cent. of the normal running speed, while initial combustion is effected by a single sparking plug operated by a hand magneto or other suitable device. Where a separate work turbine is employed only the primary turbine needs to be started initially, the work turbine being subsequently started under full load if desired, which demonstrates one particularly favourable feature of the power plant.

The following paragraphs give some details of design and construction of the main components in a gas turbine power plant for vehicles.

In general, the problem of the air cleaner, where one may be necessary, is the comparatively large volume of air to be dealt with. The Germans contemplated using a special type of cleaner and nothing is known how effective it would be in extracting concentrations of smaller particles.

An axial-flow nine-stage compressor was to be employed with a tip speed approaching the velocity of sound. The reason was mainly a question of the space likely to be available for it. It was to have been built entirely of light alloy, such material being suitable for the blades, whilst the rotor was to be built up of nine individual duralumin discs secured by eight steel bolts on a diameter approximately half that of the disc. The casing was to be cast in light alloy and to consist of two halves bolted together in the horizontal plane. Both ends of the casing are flanged to fit on to the separate compressor inlet casing at the one end and on to the outlet casing at the other. The fixed and rotary blades are fixed in the peripheral grooves in a similar manner to that used in steam turbine practice. The profile and root of the blade are integral and in between the two roots of successive blades there is a distance piece. The rotor is supported by two roller bearings, the axial thrust being balanced against the thrust of the turbine so far as possible. To avoid any thrust being transmitted from the hub of the compressor to the compressor casing, the last disc is relieved and a ring with seals is bolted by an flange to it to form an air seal with the end of the rotor casing. The only contact with the end of the casing is therefore made by these seals. All bearings are also fitted with them.

At the outlet of the compressor the outer diameter of the blading of the last stage is fixed by the dimensions of the

end of the compressor which is to fit directly on to the combustion chamber.

Unlike many jet-propulsion units, especially those employed in British practice, one combustion chamber only is used. This is circular and surrounds the turbine. Inside the chamber there is a symmetrical arrangement of 14 cones which contain the burners and through which the primary air is introduced. Admission of primary air only is individual to each burner. The secondary air is introduced from behind the cones, the tertiary air being common to the whole chamber. The secondary air is introduced from behind the cones and the tertiary through the mixing fingers placed about midway down the annular chamber. This arrangement will, therefore, have the advantage that a homogeneous mixture of hot gases of equal temperature should reach the turbine blades all the way around the turbine rotor.

Turbine data.

One advantage of this type of design of combustion chamber is that it is very compact, but, of course, it may not be possible to employ it if a heat exchanger is to be incorporated. For the primary turbine, the main data are as follows : Pressure before the turbine = 4.5 atmos.; temperature after the turbine = 500 degrees C. (932 degrees F.) approximately; speed of rotation = 14 000 r.p.m. The blades are hollow and air cooled both in rotor and stator. The temperature of the turbine is limited to 800 degrees C. in the German design on account of wartime restrictions in the use of alloying elements. The turbine has three stages, employing reaction blading, the stress on the blades not exceeding 10 to 15 kgr. per sq. mm. (6.35 to 9.5 tons per sq. in.). It was found, however, that with the cooling air in designed quantities the temperature could not be kept down to the limit, nor was it desirable in the interest of efficiency.

Cooling air for the blades was to be taken from the outlet of the compressor, as bleeding off from individual stages, which would increase efficiency by economizing the work done by the compressor was not considered practicable. The cooling air, after leaving the compressor, circulates around the combustion chamber before entering the turbine through fixed and rotary blades of special construction. This blade design consists of an outer shell and a displacement insert, and through the space between these two components the air passes with the velocity necessary to effect the required cooling. The thickness of the wall of the outer blade shell is approximately 1.5 mm. at the root and 0.5 mm. at the tip. The root of the drawn blade shell, which is square in section, is of sufficient thickness to allow welding to the rotor rim. The insert, which is made of sheet 0.2-mm. gauge, is held in position by a pin. The gap between stages is filled by U-section rings.

Construction of the individual stator blades is the same as for the rotor blades. The main advantage claimed for this construction is in the method of cooling. The large blade pitch makes possible the employment of a smaller number of blades and the cross-section of the cooling passages is small, giving a correspondingly high velocity of the cooling air. The blades are also relatively long in profile, although quite normal in British practice.

In conclusion, it is plain from the summary of the development projects for a gas turbine power plant for use in vehicles, as envisaged in Germany, that they were only in the investigation stage. No such power plant had ever been built and neither had any of the major components, except for « borrowed » part designs.

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1944 **625 .141 (**
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Report of Committee 1. **Roadway and ballast. S fications for prepared stone, slag and gravel ba** (2 000 words.)

1944 **625 .141 (**
Bulletin, Amer. Railway Engineering Assoc., No. February, p. 330.
Report of Committee 1. **Roadway and ballast. I tigate the use of asphalt in ballast.** (1 300 words.

1944 **621 .392**
Bulletin, Amer. Railway Engineering Assoc., No. February, p. 340.
Report of Committee 5. **Track. Welding of ganese castings in special trackwork.** (4 500 words & diagrams.)

4 **625 .143 .4 (.73)**
in, Amer. Railway Engineering Assoc., No. 444, ebruary, p. 417.
ort of Committee 4. **Rail.** Service tests of various of joint bars. (4 800 words, fig., tables & ms.)

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4 **625 .143 .4 (.73)**
in, Amer. Railway Engineering Assoc., No. 444, ebruary, p. 434.
ort of Committee 4. **Rail.** Investigate joint bar es and give consideration to the revision of design pecification. (3 200 words, tables & fig.)

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4 **625 .143 .3 (.73)**
in, Amer. Railway Engineering Assoc., No. 444, ebruary, p. 446.
ort of Committee 4. **Rail.** Investigate causes of spots and head checks in rail surfaces for the se of developing measures for their prevention. words, tables & fig.)

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4 **625 .143 .3 (.942)**
in, Amer. Railway Engineering Assoc., No. 446, ıne-July, p. 37.
WDERY (G. E.). — Experience with **corrugated** n Australia. (7 000 words & fig.)

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4 **621 .115 & 621 .133 .7**
in, Amer. Railway Engineering Assoc., No. 446, ıne-July, p. 57.
NIFF (R. W.). — **Steam contamination by aqua- ection.** (8 000 words & fig.)

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4 **621 .135 (01**
in, Amer. Railway Engineering Assoc., No. 447, eptember-October, p. 9.
nterbalance tests of locomotives for high speed e. (313 pages, illustrated.)

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4 **621 .133 .3 (.73)**
in, Amer. Railway Engineering Assoc., No. 448, ovember, p. 48.
se of and remedy for **pitting and corrosion of otive boiler tubes and sheets.** (600 words & fig.)

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4 **621 .134 .3 (.73)**
in Amer. Railway Engineering Assoc., No. 448, ovember, p. 59.
hanics of **foaming and carry-over in locomotive .** (2 400 words & fig.)

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4 **625 .162 (.73)**
in Amer. Railway Engineering Assoc., No. 449, ecember, p. 112.
parative merits of various types of **grade crossing tion.** (400 words & fig.)

The Engineer. (London.)

6 **691 (.485)**
Engineer, No. 4743, December 6, p. 508.
NIUS (E.). — **Deformed bar reinforcing steel** in n. (1 800 words & fig.)

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6 **624 .6 (.44)**
Engineer, No. 4743, December 6, p. 514.
onstruction of Nogent viaduct, France. (700 words)

1946 **385 .15 (.42)**
The Engineer, No. 4743, December 6, p. 515.
The **Transport bill.** (1 500 words.)

1946 **621 .131 .1 (.42) & 656 .222 .1 (.42)**
The Engineer, No. 4744, December 13, p. 532; No. 4745, December 20, p. 558.
NOCK (O. S.). — **Present-day locomotive** working in Great Britain. (3 900 words & fig.)

1946 **62 (.01 & 669 .1**
The Engineer, No. 4744, December 13, p. 536.
PULLIN (V. E.). — Common-sense of **engineering radiography.** (1 800 words.)

1946 **621 .433**
The Engineer, No. 4745, December 20, p. 559.
HODGE (J.). — **Stressing of gas turbine blading.** (3 200 words & fig.)

1946 **621 .134 .3**
The Engineer, No. 4746, December 27, p. 586.
TUPLIN (W. A.). — **Locomotive boiler pressure.** (2 800 words.)

1946 **621 .438 (.42)**
The Engineer, No. 4746, December 27, p. 590.
SPARKS (C. H.). — The future of **pulverised-coal firing** in Great Britain. (2 200 words.)

1947 **621 .131 .1 (.42)**
The Engineer, No. 4747, January 3, p. 24.
Steam locomotives in 1946. (5 000 words & fig.)

1947 **621 .431 .72**
The Engineer, No. 4748, January 10, p. 44.
BRIAN REED. — Report on **Diesel traction.** (2 200 words.)

1947 **621 .131 .3**
The Engineer, No. 4750, January 24, p. 80.
LYLE (O.). — The **compression-condensation cycles.** (1 200 words & fig.)

1947 **621 .438 (.42)**
The Engineer, No. 4750, January 24, p. 102.
Axial flow gas turbine. The Institution of Mechanical Engineers. (3 800 words.)

1947 **621 .133 .7**
The Engineer, No. 4751, January 31, p. 114.
Present day **water-tube boiler practice.** (1 800 words.)

1947 **669 .1**
The Engineer, No. 4751, January 31, p. 122.
Precipitation-hardening **stainless steels.** (700 words & fig.)

Engineering (London.)

1946 **669 .1**
Engineering, No. 4223, December 20, p. 598; No. 4224, December 27, p. 621.
MORROGH (H.). — Sulphur in **cast iron.** (4 800 words & fig.)

1947 **623 & 625 .13 (.492)**
Engineering, No. 4225, January 3, p. 1.
Repairs to war-damaged bridges in Holland. (2 800 words & fig.)

1947 **625 .14 (01 (.42)**
Engineering, No. 4226, January 10, p. 25.
ANDREWS (H. I.). — **Constant-length bar** for outdoor use. (1 100 words & fig.)

1947 **625 .214 (.42)**
Engineering, No. 4226, January 10, p. 43.
Welded steel-plate axlebox : L. M. S. Railway. (400 words.)

1947 **62. (01 & 669**
Engineering, No. 4227, January 17, p. 68.
HANSTOCK (R. F.) & LLOYD (E. H.). — X-Ray method of measuring Poisson's ratio. (1 200 words & fig.)

1947 **621 .94 (.42)**
Engineering, No. 4228, January 24, p. 80.
Profile grinding machine with optical control. (2 000 words & fig.)

1947 **385 (09 (.931)**
Engineering, No. 4229, January 31, p. 101.
New-Zealand Government railways. (1 000 words.)

1947 **621 .132 .6 (.42)**
Engineering, No. 4230, February 7, p. 128.
IVATT (H. G.). — **Light 2-6-0 freight locomotive and tender :** L. M. S. R. (2 000 words & fig.)

1947 **621 .133**
Engineering, No. 4231, February 14, p. 145.
DAVIS (R. F.). — Expansion theory of circulation in **water-tube boilers.** (5 000 words & fig.)

1947 **621 .132 .3 (.42)**
Engineering, No. 4231, February 14, p. 152.
IVATT (H. G.). — **Rebuilt passenger locomotives :** L. M. S. R. (600 words & fig.)

Journal, Institution of Civil Engineers. (London.)

1947 **625 .17**
Journal Institution of Civil Engineers, January, p. 316.
RICE (H. R.). — **Railway washaways :** Prevention and treatment of flood damage. (13 000 words, tables & fig.)

Journal, Institution of Engineers, Australia. (Sydney, N. S. W.)

1946 **621 .438**
Journal, Institution of Engineers, Australia, No. 9, September, p. 177.
Some notes on **axial vibration of turbines dics.** (2 800 words & fig.)

Journal and Proceedings, Institution of Mechanical Engineers. (London.)

1946 **669 .1**
Journal & Proceedings, Institution of Mechanical Engineers, Vol. 154, No. 3, p. 261.
ARNOLD (R. N.). — The mechanism of tool vibration in the **cutting of steel.** (24 000 words & fig.)

Journal, Permanent Way Institution. (Lond

1946 **625 .172**
Journal and report of proceedings. Permanent Institution, August, Part 2, p. 98.
DUNTON (C. E.). — Construction and mainte of **permanent way** on the railways of London Tran (5 800 words.)

1946 **625 .172 (.42) & 665 .882**
Journal and report of proceedings. Permanent Institution, August, Part 2, p. 106.
HARDING (W. E.). — **Maintenance of the perm way** by welding. (1 300 words.)

1946 **625 .151**
Journal and report of proceedings. Permanent Institution, August, Part 2, p. 108.
Flat bottom track. Design of **switches and cro** in 110 lb. B. S. F. B. rail. (2 200 words & fig.)

The Locomotive. (London.)

1946 **621 .132 .8 (.42) & 621 .438**
The Locomotive, No. 652, December 14, p. 177.
The L. M. S. **turbine locomotive.** (900 words &

1946 **621 .132 .3**
The Locomotive, No. 652, December 14, p. 178.
German **2-10-0 locomotive.** (500 words.)

1946 **621 .132 .8**
The Locomotive, No. 652, December 14, p. 187.
BOND (R. C.). — Ten years experience wit L. M. S. **non-condensing turbine locomotive** No. (2 200 words.)

1946 **621 .132 .1**
The Locomotive, No. 652, December 14, p. 190.
DERENS (L.). — The Dutch State Railways C be continued). (2 400 words & fig.)

1947 **621 .132 .4 (.42) & 621 .132 .6**
The Locomotive, No. 653, January 15, p. 5.
New **L. M. S. locomotives.** (800 words & fig.)

Mechanical Engineering. (New York.)

1946 **621 .132 .8 (.73) & 621 .438**
Mechanical Engineering, October, p. 912.
HAGUE (F. T.). — Future **use of coal** in r motive power. (1 800 words & fig.)

1946 **625 .23 (.73) & 625 .234**
Mechanical Engineering, December, p. 1041.
HANFT (H. H.). — **Passenger-car electrica heating equipment.** Analysis of equipment weig duction in modern railway cars. (3 000 words.)

1946 **621 .133 .3 (.73) & 621 .392**
Mechanical Engineering, December, p. 1082.
ADAIR (J. G.). — **Locomotive boilers. Welde struction.** (2 000 words.)

Modern Transport. (London.)

46 **385 (09 (47)**
ern Transport, September 28, p. 15.
velopment of **Soviet railways.** The new five-year (700 words & maps.)

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46 **625 .232 (.42)**
ern Transport, October 5, p. 5.
w rolling-stock for L. M. S. R. Corridor third-coaches. (700 words & fig.)

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46 **656 (.42)**
ern Transport, October 12, p. 8.
national transport plan. Proposal of R. C. A. con-ce. (1 400 words.)

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46 **625 .142 (.42) & 625 .143 (.42)**
ern Transport, October 12, p. 9.
e-assembled track for renewals. Southern Railway vation. (800 words & fig.)

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46 **621 .132 .6 (.41)**
ern Transport, October 12, p. 15.
nk locomotives for Northern Ireland. (900 words .)

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46 **385 .3 (.42)**
ern Transport, October 19, p. 3.
ilway Companies' case against State ownership. 0 words.)

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46 **621 .138 .3 (.42) & 621 .138 .5 (.42)**
ern Transport, October 19, p. 9.
ACDONALD (J. F. S.). — **Locomotive running rs.** Reducing time in sheds. (2 300 words.)

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46 **625 .231 (.44)**
ern Transport, October 19, p. 20.
odern French **railway vehicles.** (300 words & fig.)

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46 **625 .61 (.42)**
ern Transport, October 26, p. 4.
oblem of track costs. (1 200 words.)

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46 **621 .13 (0 (.42)**
ern Transport, October 26, p. 9.
JLLEID (O. V.). — New conception of **steam loco-ve design.** Lessons for the immediate future. (4 200 s.)

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46 **621 .132 .3 (.42)**
ern Transport, October 26, p. 17.
HALLEY (F. S.). — British-built **Liberation loco-ve.** (2 100 words.)

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46 **621 .336 (.42)**
ern Transport, November 2, p. 9.
nductor rail current collection. Spring-borne shoe-(500 words & fig.)

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46 **691**
ern Transport, November 9, p. 3.
istics in post-war transport development. (2 100 s & fig.)

1946 **351 .812 .1 (.94)**
Modern Transport, November 9, p. 17; November 23, p. 15.
CLAPP (H.). — **Railway Administration** in Australia. (2 400 words.)

1946 **621 .138 .1 (.42)**
Modern Transport, November 16, p. 3.
Operation of **oil-fired steam locomotives.** G. W. R. practice and experience. (1 800 words & fig.)

1946 **625 .245 (.42)**
Modern Transport, November 16, p. 8.
Rail **transport out-of-gauge loads.** Moving a stator from Tyneside to Birmingham. (700 words & fig.)

1946 **621 .33 (.42)**
Modern Transport, November 16, p. 15.
VARLEY (R.). — **Electrification** on British Railways. (1 200 words.)

1946 **625 .42 (.42)**
Modern Transport, November 23, p. 3.
Eastern Section of **L. P. T. B. Central Line.** (1 600 words, fig. & map.)

1946 **625 .232 (.42)**
Modern Transport, November 23, p. 5.
New Great Western **coaches.** (900 words & fig.)

1946 **656 .225 (.73)**
Modern Transport, November 23, p. 9.
WALKER (G.). — **Regulator of goods transport** in the U. S. A. Effect of existing legislation. (800 words.)

1946 **625 .232 (.42)**
Modern Transport, November 23, p. 10.
Private railway car for business journeys. Design for a travelling office-flat. (960 words & fig.)

1946 **656 (.73)**
Modern Transport, November 23, p. 17.
Transport conditions in the U. S. A. Meeting road and air competition. (2 000 words & fig.)

The Oil Engine. (London.)

1946 **621 .132 .8 (.42) & 621 .438 (.42)**
The Oil Engine, December, p. 252.
The G. W. R. **gas-turbine locomotive.** (600 words & fig.)

1946 **656 .25 (.42)**
The Oil Engine, December, p. 255.
Emergency air supply for **railway signalling.** (400 words & fig.)

1946 **621 .438 (.42)**
The Oil Engine, December, p. 256.
Free-piston engines in production. (1 200 words & fig.)

1946 **621 .132 .8 (.42) & 625 .215 (.42)**
The Oil Engine, December, p. 258.
British rail vehicles for export. **Power bogies** for 25 cars under construction. (600 words & fig.)

1946 **621 .13 (.73)**

The Oil Engine, December, p. 264.
Quantity production of U. S. A. **locomotives.** (2 400 words & fig.)

1946 **621 .132 .7 (.42) & 621 .438 (.42)**

The Oil Engine, December, p. 273.
L. M. S. R. **shunter experience.** (900 words.)

Railway Age. (New York.)

1946 **625 .162 (.73)**

Railway Age, October 12, p. 596.
BENESCH (A.). — **Grade separations** will not solve growing crossing menace. (1 000 words & fig.)

1946 **656 .254 (.73)**

Railway Age, October 12, p. 600.
Radio and carrier controls for C. T. C. on Pennsylvania. (1 400 words & diagrams.)

1946 **625 .25 (.73)**

Railway Age, October 12, p. 604.
STEWART (C. D.). — Recent developments in **speed controls.** (4 500 words & fig.)

1946 **621 .132 .8 (.73) & 621 .438 (.73)**

Railway Age, October 19, p. 636.
Santa Fe buys new design **road Diesel.** (4 200 words & fig.)

1946 **621 .431 .72 (.73)**

Railway Age, October 26, p. 674.
The Electro-motive type F-3 **Diesel locomotive.** (3 000 words & fig.)

1946 **656 .25 (.73)**

Railway Age, October 26, p. 680.
Signal section holds annual meeting. (3 200 words & portraits.)

1946 **625 .153 (.73)**

Railway Age, October 26, p. 684.
BEEBE (T. H.). — **Unusual methods for big track-work job.** (2 400 words & fig.)

1946 **656 .211 .5 (.73) & 656 .212 .6 (.73)**

Railway Age, October 26, p. 687.
PETERSON (C. G.). — Better service for **express customers.** (2 200 words & fig.)

1946 **621 .138 .5 (.73)**

Railway Age, November 2, p. 716.
Couverts shop for Diesel repairs. (3 000 words & fig.)

1946 **625 .26 (.73)**

Railway Age, November 2, p. 723.
Old passenger cars. Retire or rebuild ? (3 500 words.)

1946 **625 .143 .1**

Railway Age, November 9, p. 752.
A. R. E. A. adopts three **new rail designs.** words & fig.)

1946 **656 .212 .6**

Railway Age, November 9, p. 761.
Mechanized equipment speeds deliveries. (1 800 & fig.)

1946 **656 .254**

Railway Age, November 9, p. 764.
Carryphone in service on Pennsylvania. (1 000 & fig.)

1946 **625 .21**

Railway Age, November 9, p. 768.
High speed **freight car truck.** (700 words & fig

1946 **625 .232**

Railway Age, November 16, p. 806.
What will **new passenger cars** be like ? (3 000 & fig.)

1946 **625 .233 & 62**

Railway Age, November 16, p. 815.
Car air conditioning and lighting. (2 000 words &

1946 **621 .138 .5**

Railway Age, November 23, p. 868.
Scranton **Diesel shop** is different. (3 200 words &

1946 **625 .244**

Railway Age, November 23, p. 875.
I. C. builds **aluminum refrigerator car.** (2 800 & fig.)

1946 **621 132 .3**

Railway Age, November 30, p. 927.
Canadian Pacific **converted locomotives.** (500 & fig.)

1946 **725 .31**

Railway Age, December 7, p. 952.
SHERRILK (J. C.). — What about our **r stations.** (1 400 words & fig.)

1946 **625 .254**

Railway Age, December 7, p. 958.
L. & N. installs **C. T. C.** on 107 miles. (1 000 & fig.)

1946 **625 .232**

Railway Age, December 14, p. 996.
Louisville and Nashville **streamliners.** (5 000 & fig.)

1946 **621 .138 .5**

Railway Age, December 14, p. 1004; Decemb p. 1042.
Burlington builds three **Diesel shops.** (6 800 & fig.)

Railway Engineering and Maintenance. (Chicago.)

46 **625 .143 (.73)**

vay Engineering and Maintenance, January, p. 56; February, p. 155.
nois Central overcomes adverse conditions on Cairo e. (4 800 words & fig.)

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46 **725 .33 (.73)**

vay Engineering and Maintenance, Febr., p. 169; April, p. 431.
NOWLES (C. R.). — Maintaining **water service ties. Tanks.** (4 400 words & fig.)

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46 **625 .144 .4**

vay Engineering and Maintenance, March, p. 281.
ail rail gang gets machines. Output soars. (3 300 s & fig.)

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46 **625 .144 .4 (.73)**

vay Engineering and Maintenance, March, p. 284.
ork equipment a big factor in A. C. L. **Track rehation.** (4 300 words & fig.)

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46 **625 .13 (.73)**

vay Engineering and Maintenance, March, p. 296.
e strikes B. E. M. bridge again. Machines help **reconstruction.** (4 200 words & fig.)

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46 **625 .142 .2 (.73) & 691 (.73)**

vay Engineering and Maintenance, April, p. 421.
asoning ties in hours instead of months. (3 100 s & fig.)

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46 **698 & 725 .3**

vay Engineering and Maintenance, May, p. 524.
or dynamics. An aid to safety, comfort and effiy. (2 100 words & fig.)

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46 **625 .143 .4 (.73)**

vay Engineering and Maintenance, May, p. 529.
elded rail. After 13 years on the Delaware & Hud- (5 100 words & fig.)

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46 **625 .13 (.73) & 625 .144 .4 (.73)**

vay Engineering and Maintenance, June, p. 628.
ying continuous rails in Santa Fe tunnel. (1 800 s & fig.)

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46 **695**

vay Engineering and Maintenance, June, p. 630.
tion dome gets aluminium roof. (2 100 words .)

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46 **691**

vay Engineering and Maintenance, June, p. 633.
el straps hold forms for encasing **concrete columns.** words & fig.)

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46 **725 .33**

vay Engineering and Maintenance, June, p. 635.
intaining **water service facilities.** Water columns. 0 words & fig.)

Railway Gazette. (London.)

1946 **385. (09 (.51)**

Railway Gazette, No. 11, September 13, p. 294.
CHEN (S. S.). — Re-opening the **Canton. Hankow Railway.** (700 words & map.)

1946 **621 392 (.42) & 625 .144 .1 (.42)**

Railway Gazette, No. 11, September 13, p. 296.
Portable welders for joining rails. (1 200 words & fig.)

1946 **621 .335 (.494)**

Railway Gazette, No. 11, September 13, p. 297.
Swiss traction equipment developments. (1 000 words & fig.)

1946 **621 .335 (.42)**

Railway Gazette, No. 11, September 13, p. 300.
Shoe beams on London Transport rolling stock. (500 words & fig.)

1946 **625 .25 (.71)**

Railway Gazette, No. 11, September 13, p. 301.
« **Sleepy Hollow** » **chairs** for C. P. R. coaches. (210 words & fig.)

1946 **621 .132 .1 (.68)**

Railway Gazette, No. 12, September 20, p. 321.
Additional **4-8-2 class « 15 F » locomotives** for the South African railways. (1 400 words & fig.)

1946 **625 .13 (.492)**

Railway Gazette, No. 12, September 20, p. 329.
The **greatest bridge in Holland temporarily reconstructed.** (350 words & fig.)

1946 **388 (.42)**

Railway Gazette, No. 12, September 20, p. 333.
Planning of London and its effect on the railways. (2 100 words & fig.)

1946 **656 .255 (.42)**

Railway Gazette, No. 12, September 20, p. 337; No. 13, September 27, p. 363.
Railway Charges Consultative Committee. Opening of inquiry into **adjustment of rates and fares.** (5 500 words.)

1946 **625 .143 .3 (.73)**

Railway Gazette, No. 13, September 27, p. 345.
Flat-bottom rail defects. (720 words.)

1946 **385. (071 .3 (.42)**

Railway Gazette, No. 13, September 27, p. 351.
LARKIN (E. J.). — The progressive system of **workshop training.** (2 800 words, tables & fig.)

1946 **388 (42)**

Railway Gazette, No. 13, September 27, p. 361.
Underground railways and the planning of London. (1 200 words.)

1946 **62 .04 (.73)**

Railway Gazette, No. 14, October 4, p. 381.
The development of American **railway research.** (1 400 words.)

1946 **656 .253 (.42)**

Railway Gazette, No. 14, October 4, p. 382.
Air compressors for **electro-pneumatic signalling.** (700 words & fig.)

1946 **625 .232 (.42)**

Railway Gazette, No. 14, October 4, p. 384.
New **corridor third class coaches** L. M. S. R. (1 000 words & fig.)

1946 **621 .132 .3 (.431)**

Railway Gazette, No. 14, October 4, p. 387.
New **light 4-8-2 locomotives** for New Zealand. (1 200 words & fig.)

1946 **621 .338 (.42)**

Railway Gazette, No. 15, October 11, p. 410.
New **all-steel electric sets,** Southern Railway. (300 words & fig.)

1946 **621 .33 (.460)**

Railway Gazette, No. 15, October 11, p. 411.
Large Spanish **electrification programme.** (1 400 words & map.)

1946 **621 .133 .4 (.73)**

Railway Gazette, No. 15, October 11, p. 413.
Prevention of locomotive smoke. (2 200 words & fig.)

1946 **625 .215 (.73)**

Railway Gazette, No. 15, October 11, p. 416.
The Barber **stabilised freight-wagon bogie.** (400 words & fig.)

1946 **625 .225 (42) & 656 .261 (.42)**

Railway Gazette, No. 15, October 11, p. 417.
L. M. S. R. new **insulated containers.** (600 words & fig.)

1946 **625 .232 (.42)**

Railway Gazette, No. 15, October 11, p. 418.
Design for new-type **sleeping car.** (700 words & fig.)

Railway Mechanical Engineer. (New York.)

1946 **621 .431 .72 (.73)**

Railway Mechanical Engineer, June, p. 318.
Diesels to replace electrics. (2 000 words & fig.)

1946 **621 .133 (.73)**

Railway Mechanical Engineer, July, p. 339.
Alco **all-welded boilers.** (2 400 words & fig.)

1946 **621 .134 .1**

Railway Mechanical Engineer, July, p. 344.
MILLER (R. B.). — Large or small **cylinder** ter. (1 400 words & fig.)

1946 **625 .234**

Railway Mechanical Engineer, July, p. 345.
MUNKELT (F. H.). — Car **air purification.** words & fig.)

1946 **625 .243**

Railway Mechanical Engineer, July, p. 347.
American Car and Foundry builds covered car. (800 words & fig.)

1946 **621 .134 .1**

Railway Mechanical Engineer, July, p. 358.
Marshall Shops make **nickel-steel driving rods.** words & fig.)

1946 **621 .32**

Railway Mechanical Engineer, July, p. 364.
Shop and office **lighting.** (2 100 words & fig.)

1946 **625 233**

Railway Mechanical Engineer, July, p. 370.
MANSON (A. J.). — **Lighting of passenger** (2 100 words & fig.)

1946 **621 .132 .8 (.494) & 621 .438**

Railway Mechanical Engineer, August, p. 394.
GIGER (W.). — **Gaz turbine locomotives.** words & fig.)

1946 **62**

Railway Mechanical Engineer, August, p. 400.
KENYON (Reid L.). — **Thermal stresses in wr steel wheels.** (4 200 words & fig.)

1946 **62**

Railway Mechanical Engineer, August, p. 416.
GRISBAUM (L. D.). — A future for the st **journal-box ?** (3 800 words & fig.)

1946 **62**

Railway Mechanical Engineer, August, p. 427.
MANSON (A. J.). — **Lighting of passenger** (3 000 words & fig.)

1946 **625 .2**

Railway Mechanical Engineer, September, p. 452.
Mechanical Division. Report of the Committ **car construction.** (2 400 words & fig.)

1946 **621 .131 .2 (.73) & 621 .431 .72**

Railway Mechanical Engineer, September, p. 475.
Mechanical Division. Report on **locomotive co tion.** (4 500 words, diagrams & fig.)

6 **656 .254 (.73)**

ay Mechanical Engineer, September, p. 484.
thern Pacific tests **radio on freight trains.** (2 000 & fig.)

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6 **537 .8 (73)**

ay Mechanical Engineer, September, p. 487.
m **D. C. to A. C.** with profit. (1 100 words & fig.)

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6 **625 .231 (.73)**

ay Mechanical Engineer, October, p. 517.
ctrically lighted cabooses. (800 words & fig.)

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6 **656 .254 (.73)**

ay Mechanical Engineer, October, p. 518.
lio in railroad tunnels. (500 words.)

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6 **621 .32 (.73)**

ay Mechanical Engineer, October, p. 519.
hting « trolley » for enginehouses. (600 words.)

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6 **621 .13 (.06 (.73) & 385. (07 (.73)**

ay Mechanical Engineer, October, p. 526.
omotive officers meet. Annual meeting at Chicago
lers reports on the **training of personnel,** steam
Diesel maintenance and safety promotion. (9 000
& fig.)

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6 **625 .2 (06 (.73)**

ay Mechanical Engineer, October, p. 541.
ad program features C. D. O. A. annual meeting.
nittees propose **revisions of rules and lubricating**
ice. Wide range of repair practices and facilities
yed. Detail study of wheelshop facilities to turn out
airs of wheels each 8-h. day. (8 000 words & fig.)

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